RECENT TRENDS IN THE REAL ESTATE MARKET AND ITS ANALYSIS

Scientific Editors
Jacek Łaszek Krzysztof Olszewski Roman Sobiecki

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OFICYNA WYDAWNICZA SGH
SZKOŁA GŁÓWNA HANDLOWA W WARSZAWIE
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Leszek Pawłowicz

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Introduction

Real estate plays an enormous role in developed economies, as residential real estate is used to satisfy the basic housing needs of the population, while commercial real estate is used in the global production chains. Commercial real estate gives place for firms which create the biggest value added in the production chain, namely the research and development in the beginning of the process and the services related to each product at the end of the production process. Also, the planning of the production, logistics, its financing and finally the sale and after-sale services are generated in modern office buildings. Those processes produce the biggest share of value added and are located in the biggest metropolises and attract skilled workers, who have better payed jobs than the average population. Those people can spend more money in shopping malls and ask for better living conditions, often buying housing with a mortgage.

The main problem of the real estate market is its cyclical nature and the fact that tensions in this market often lead to severe financial and economic crisis. The cycles are long and emerge from the fact that it takes a while until the supply catches up with the very flexible demand. The demand tends to build up for a prolonged time and then to drop abruptly, leading to oversupply and price declines. The real estate market reacts strongly to the economy, as even a modest economic growth accelerates demand for real estate. The real estate market is by and large financed by banks, and price declines make the collateral for mortgages shrink, and as a consequence of banking crises we observe crises of the whole economy. Such a crisis makes demand decline even further, until a bottom is reached. Even though there is a good knowledge about the past crises, new crises tend to emerge. This shows that it is very difficult ex post to determine tensions and to take the appropriate countercyclical measures.

The thorough analysis of cycles, the detection of tensions that can lead to a crisis and the role of the housing and monetary policy are the main value added of the present book. The chapters constitute a step stone in the ongoing academic discussion and try to give more insight into this important topic.

The second important problem that is covered in this book is the financing of real estate and the architecture of the financial system. This problem is directly connected with the cyclicality of the real estate market and the fact that this market can generate crises. The financial system is usually the main suspect and also the main casualty of real estate booms and busts, but without the financial system the real estate market could barely function in an efficient way.

The third problem that is discussed in this book is the local and national character of the real estate sector. In the first place, real estate is immobile, and further, local laws and regulations, which can differ even among member states of the European Union, shape the sector in various ways. As a consequence, it is not easy to draw from the experience of other countries, as sometimes different triggers can lead to the same results, while in other situations the same triggers can lead to very different outcomes. The knowledge of this fact can help politicians in making the optimal decisions, however it is challenging for analysts and researchers.

The fourth task of the book is the analysis of the commercial property market functioning. So far, the literature is mainly concerned about residential real estate. But the fast development of the commercial real estate sector, the huge amount of financing which it attracts and the tensions which emerge more frequently around it make researchers more aware of this market and its problems.

1. Housing market and the financial sector

Christophe André and Thomas Chalaux describe **Real estate booms, recessions and financial crises** and conclude that real estate busts are often connected with deep recessions and financial crises. The main causes of real estate bubbles are the rapid expansion of credit, excessively easy monetary policy, excessive leverage and destabilizing international capital flows and financial deregulation. Authors propose policy responses which deal with the prevention and crisis management.

Indranarain Ramlall states in **Establishing a framework for financial stability risk assessments in the real estate sector** that the real estate sector is an important element, which transmits risks to an economy. The author presents a broad overview about how the sector functions, pinpoints its structural elements and sectorial risks, how this sector is connected with the economy and how it can generate risks. Based on this enumeration the author describes the tools that can be used to minimize these risks and discusses these tools.

The management of risk in the real estate sector relies on the management of risk of the financing bank (mortgage policy, capital reserves, risk measures), the risk of the collateral (proper valuation) and the risk of the mortgage taker (ability to pay back the mortgage). The real estate market has a cyclical nature, therefore it is crucial to have proper and timely valuations of mortgage financed property, and to be able to foresee how those valuations could change over the cycle. Property valuation was done until recently by valuers, who use their best knowledge and experience and usually a rather small sample of other properties that serve as a reference point. Currently the development of huge data bases which contain property prices and their attributes and also the development of econometric modeling have changed the tools that can be used for valuation purposes.

A novel valuation method are the Automated Valuation Models. Those models are generated on a vast amount of transaction data, which were properly prepared for the regression, thus this method should perform better than the average valuer who usually bases on few observations. However, the owners of such tools do not want to show the estimation model, which could be easily replicated and their business would be gone. This method is prone to cyclicality in the same way as any valuation method, however it could give easy access to mass appraisals which would help to reduce the risk of the cycle. George Matysiak in **Automated Valuation Models (AVMs): Here to stay** describes the evolution of valuation methods from traditional sales comparison methods and valuer assessments towards an automated system, which generates valuations based on regressions. He finds that the AVM are and will be an important tool, but should not be seen as a substitute for usual valuations but rather as a complementary tool, which the valuer can use to improve his valuation.

As mentioned above, an important risk factor in the real estate market is the financial soundness of households that have a mortgage. Virgilijus Rutkauskas, Darius Kulikauskas and Vaidotas Šumskis analyze the **Financial soundness of Lithuanian households and the stability of the financial sector.** The authors run a stress test on the households' financial margins, which is the difference between income and expenditures for consumption and the payment of mortgages. They find that households who have a mortgage and banks that finance such mortgages are resilient to financial difficulties.

Jacek Łaszek, Krzysztof Olszewski and Hanna Augustyniak present **A simple model of the housing market and the detection of cycles** and analyze three cycles in the 1994–2017 period. Authors do not measure tensions on the market that are generated by its cyclicality, but rather try to understand how the determinants of the supply and demand side work. Housing is a durable consumer good and an investment object at the same time. The analysis shows that even the three cycles look similar, they are generated by various combinations of income, interest rates and regulatory shocks. An emphasis should be put on the interactions of various economic factors in the creation of cycles.

Hanna Augustyniak, Robert Leszczyński, Jacek Łaszek, Krzysztof Olszewski and Joanna Waszczuk present an **Empirical analysis of the determinants of the housing cycle in the primary housing market and its forecast.** Their four equations model describes the main drivers of housing demand and supply in the primary housing market in Warsaw. Authors find that housing demand is mainly driven by rises in income and interest rate declines, and that the appreciation of housing boosts its demand. The supply of housing rises if increases in prices are higher than increases in construction costs. The model bases in fact on the mortgage cycle and explains the dynamics of the housing market in light of the mortgage cycle. However, the model lacks structural and demographic factors and also does not capture investment demand for housing.

Wanda Cornacchia and Mara Pirovano introduce **A guide to early warning models for real estate-related banking crises.** Authors stress that the recent financial crisis has shown that unfavorable developments in real estate markets can lead to financial instability. To counter this problem, early warning models should be used by macroprudential policymakers in the risk assessment framework of the real estate market. Such models should be considered as complementary to the structural models. The main drawback of structural models is that they are estimated and calibrated on past events, usually using aggregate data. However, those past events can have a different background than the current situation, thus the structural model might not be the best tool to understand the current situation and to draw policy conclusions.

Michał Wydra analyzes in **Mortgage insurance, its effectiveness and impact on financial stability based on selected crises – recommendations for Poland** how mortgage insurance works and finds that foreign experience indicates that the implementation of mortgage insurance had a huge impact on the stability of the financial sector, its resistance to a downturn and risk diversification. Author presents a list of recommendations which the USAID created and gives examples about the implementation of those instruments in Poland. However, the last experience shows that the insurance sector which theoretically should be suitable for the systemic risk management, has failed in many cases.

Piotr Śliwka presents in **Proposed methods for modeling the mortgage and reverse mortgage installment** how the reverse mortgage in Poland can work if firms and clients apply the rules that were introduced by law. The article presents in mathematical details the methods of modeling the mortgage pension and reverse mortgage based on the estimation of the actuarial model and the econometric model and discusses the results. A reverse mortgage is a good example of equity withdrawal.

2. Country experience

Michael Lea presents a detailed analysis of the **US housing finance policy in the aftermath of the crisis.** Author first points out that the crisis was generated by a whole branch of triggers, among which are the credit bubble, the government housing policy which strongly supported mortgage lending to low and moderate income households. The government has introduced many small improvements, but the author stresses that there was no significant change in the US housing finance system, the economy still depends on housing while the mortgage market depends on government subsidies, which makes the whole economy prone to another boom and bust cycle.

Karin Wagner and Christian Beer analyze the **Households' housing expenditure in Austria, Germany and Italy** on data from the 2014 Household Finance and Consumption Survey. They find that the share of housing expenditure is the lowest in Italy and the highest in Germany. They find that homeowners have lower expenditures than tenants, and as more Italians are homeowners than Germans, this explains the difference in the expenditures.

Piotr Kasprzak investigates in the **Moral hazard of indebted households as a potential threat to macroeconomic stability – observations from the Spanish real estate bubble** the behavioral causes of the last financial crisis. When Spain entered the European Monetary Union, interest rates fell sharply and housing finance became quite cheap. It became profitable for nearly everybody to engage in the real estate market, and as the author concludes, economic growth was partially based on the bubble in the housing market, and the moral hazard was accumulating everywhere.

The analysis of property prices is crucial for the identification of tensions in the market. However, the quality and location of housing is very much heterogenous, thus advanced econometric theory and regressions are needed, which help to make such houses comparable. The advanced geostatistical regression model seems to be a promising tool. Joanna Waszczuk compares in **Estimation of housing prices – comparison of spatial methods in Warsaw housing market** two geostatistical methods which can be used to valuate housing: inverse distance weighting interpolation and ordinary kriging. This is a quite novel approach, which has been rarely applied before in the case of the Polish housing market. The paper indicates that the use of spatial information improves the analysis of house prices and this analysis should be extended to other cities.

In some cases, good market data is no easily available, and in such a case indicator models which base on changes in income levels, mortgage availability, unemployment and demographic changes can be a feasible solution. Andrei Radulescu describes in **The housing prices in Romania – recent developments** the evolution of the housing market in the post-crisis period. Real disposable income was growing, and real financing costs were very low and the evolution of house prices follows closely the dynamics of the EU housing prices.

Tomas Reichenbachas asks in **"Down the rabbit-hole": Does monetary policy impact differ during the housing bubbles?** He first creates a method to pinpoint housing bubbles and then investigates whether tighter monetary policy can hinder the build-up of a housing bubble.

Filali Adib Fatine, and Firano Zakaria apply in **Bubble on the Moroccan real estate market: identification, cycles and macroeconomic conditions** several approaches to identify and explain the real estate bubble. They find that there was a speculative bubble during the period 2006–2008, which can be explained mainly by the credit boom of the credit during the same period.

3. Commercial real estate

Krzysztof Olszewski, Paweł Decyk, Krystyna Gałaszewska, Andrzej Jakubowski, Magdalena Kulig, Renata Modzelewska and Hanna Żywiecka present the **Hedonic analysis of office and retail rents in three major cities in Poland.** The authors describe three cities, pointing out that Warsaw and Poznań are monocentric cities, while Tricity is polycentric. Both the office and the retail market in the three cities differ quite considerably, thus for each city a separate hedonic model is estimated.

Dariusz Trojanowski, Krzysztof Olszewski and Krystyna Gałaszewska analyze **The robustness of office building investment in the low interest rate environment** on empirical data for B-class office buildings. The authors first present in detail how the free cash flow for the investor and the debt service to income is calculated. In a second step they show how rising vacancy rates or interest rates or both, under two LTC scenarios, affect the ROE and the DSTI of and office investment.

Jacek Łaszek
Krzysztof Olszewski
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Chapter 1

Real estate booms, recessions and financial crises

Christophe André and Thomas Chalaux[1]

Bursting real estate bubbles are often followed by deep and protracted recessions and financial crises. Most recently, the US subprime crisis was at the epicenter of the global financial crisis (GFC) which started in 2007. Moreover, the GFC came after an unprecedented global housing boom and was associated with major real estate finance crises in many countries, including Hungary, Iceland, Ireland, Spain and the United Kingdom. Although historical episodes exhibit specific characteristics, bubbles share common features. A rapid credit expansion is generally unleashed by a combination of easy credit conditions, and financial deregulation and innovations. In most cases, foreign capital inflows play a major role. Easy access to cheap credit fuels demand for real estate, as well as other assets. As supply of real estate is inelastic, at least in the short run, prices shoot up. In turn, rising prices lead to expectations that prices will rise further, which stimulates demand even more. In some cases, construction overshoots, while in others the supply response is muted. The intensity of the supply response has important implications for real estate price dynamics and financial stability, as loans to highly leveraged real estate developers and construction companies tend to generate much more defaults than residential mortgages during downturns. When bubbles burst and real estate prices collapse, the economy often goes into recession and losses accumulate in financial institutions.

Nevertheless, not all real estate booms end up with a financial crisis. And even for those financial crises which are associated with a real estate bust, the latter is

[1] Christophe André and Thomas Chalaux, OECD Economics Department.
The views expressed in this chapter are those of the authors and do not necessarily reflect the official views of the OECD or its member countries. The authors would like to thank participants in the Narodowy Bank Polski and SGH Warsaw School of Economics Conference recent trends in the real estate market and its analysis 2017 for useful comments and suggestions.

often only part of the story. From a policy point of view, it is essential to understand the extent to which a financial crisis finds its origin in real estate developments, or whether those are only a part, however important, of wider economic and financial imbalances. Failing to understand the true causes of financial crises would make it impossible to prevent future crises, even though some policy measures may mitigate their impact. For example, better financial regulation could help to avoid a repeat of the worst excesses of the US subprime crisis. It is by no means certain that this would prevent another global financial crisis. In this chapter, we try to shed light on the drivers of real estate booms and on the risks that particular characteristics of these booms imply for the financial system and the wider economy. This may help detecting early warning signals and taking policy measures to address the main vulnerabilities of housing and real estate finance systems. The chapter is organized as follows: first, we document housing price cycles in a large sample of OECD countries over almost five decades. Second, we provide an overview of the main financial crises in recent history, focusing on the role of real estate. Third, we outline the main mechanisms at play in a typical housing boom-bust cycle. We conclude with some remarks on the role of policies in preventing and responding to financial crises.

1. Real housing price cycles in OECD countries

Looking at real housing prices in a sample of 20 OECD countries since 1970[2], we identity 139 upturns and downturns, amounting to an average of 3.5 of each phase per country (Table 1). The cycles last on average twelve years, with prices typically rising 60% over seven years, before falling 20% over the next five years. During upturns, real GDP and private consumption grow at an average annual rate of about 4%, compared with around 1.5% in downturns. Real housing investment jumps on average nearly 50% during upswings and contracts by close to 20% in downturns. The price-to-rent and price-to-income ratios are respectively 9% and 15% above their long-term averages at cycle peaks, and 20% and 12% below at troughs.

The global real estate boom which ended in the midst of the Global Financial Crisis (GFC), between the end of 2006 and 2008 depending on the country, displays exceptional characteristics compared to the previous upturns. While major upturns[3]

[2] Data are only available from 1986 for South Korea, 1988 for Portugal and 1971 for Spain.

[3] Major cycles in this paper are defined as cycles where the prices change during a cycle phase (upturn or downturn) is at least 15%. Following this definition, 53 upturns and 36 downturns have been identified since 1970.

last seven years on average, this expansion lasted more than ten years in most of the countries in the sample. Large real housing price falls in the United States from the end of 2006 were followed within about a year by the start of deep and protracted contractions in seven other countries. In most countries, prices bottomed out after five to six years, at levels ranging from about 20% to more than 50% below their peak levels (Table 2). The exceptional length of the housing expansion before the GFC also led to a disconnection from the business cycle, to which the real estate cycle is usually closely related (Figure 1, Panel A). Synchronization resumed after the GFC. Another striking characteristic of the pre-GFC upswing was the simultaneity of booms across countries. Before the cycle peak, fourteen out of the eighteen examined countries were in a boom, defined as an increase in real housing prices of 25% or more over five years. This compares to respectively six and eleven in the expansions of the 1980s and 1990s (Figure 1, Panel B). Germany, Switzerland, and Japan were the only countries escaping a boom[4]. To assess the synchronization of the downturn, given some degree of asymmetry in the housing cycle, we look at the number of countries with real housing prices falling by more than 5% over a year. Following the GFC, ten countries experienced falls of this magnitude, which compares with the numbers observed in the 1980s and is only slightly more than those of the 1990s (Figure 1, Panel C).

Table 1. Real housing price cycles from 1970: averages across countries

	Number	Length	Housing prices	GDP	Housing investment	Private consumption	Price-to-rent	Price-to-income
		Quarters	% change				At peak / trough	
Upturns	3.5	27.5	59.7	28.8	48.4	28.9	109.1	115.3
Downturns	3.5	20.8	–21.1	8.4	–17.7	6.9	80.5	87.9
			Annualized % change					
Upturns			8.7	4.2	7.0	4.2		
Downturnss			–4.1	1.6	–3.4	1.3		

Notes: The cycles are defined using the Bry-Boschan (1971) dating procedure, with a minimum cycle phase (upturn or downturn) length of six quarters. Housing prices, GDP, housing investment and private consumption refer to the percentage change in real terms over the cycle phase. Price-to-rent and price-to-income refer to the values at peak and trough relative to their long-run averages normalized to 100. The breakdown by country is provided in the annex, Table A.1.

Source: OECD Analytical house prices and Economic Outlook database.

4 Finland reached the boom threshold when prices were already decelerating in the Netherlands, which explains that the maximum number of countries in a boom is 14 out of 18.

Table 2. Major real house price cycles by country[1]

Country	Upturns			Downturns		
	Start	End	Price change[2]	Start	End	Price change[2]
Australia	1970Q1	1974Q1	35.8	1974Q1	1978Q4	–16.6
	1987Q1	1989Q2	36.8			
	1996Q1	2004Q1	84.6			
	2005Q3	2010Q2	25.1			
Belgium	1971Q3	1979Q3	61.4	1979Q3	1985Q2	–38.2
	1985Q2	2013Q1	177.6			
Canada	1970Q1	1976Q4	44.5	1976Q4	1985Q1	–21.6
	1985Q1	1989Q1	62.3	1989Q1	1998Q3	–15.7
Denmark	1970Q4	1973Q3	24.8			
				1979Q2	1982Q3	–34.5
	1982Q3	1986Q1	59.0	1986Q1	1993Q2	–34.1
	1993Q2	2007Q1	178.9	**2007Q1**	**2012Q2**	**–28.2**
Finland	1970Q1	1973Q4	18.4	1973Q4	1979Q1	–29.6
	1979Q1	1984Q3	36.3			
	1986Q2	1989Q2	66.0	**1989Q2**	**1993Q2**	**–47.3**
	1993Q2	2007Q3	86.8			
France	1971Q2	1980Q4	39.8	1980Q4	1984Q3	–18.3
	1984Q3	1991Q2	33.8	1991Q2	1997Q1	–17.2
	1997Q1	2007Q4	116.6			
Germany				1995Q1	2008Q3	–20.8
Ireland	1970Q1	1979Q2	62.8	1979Q2	1987Q2	–27.8
	1987Q2	2007Q1	346.6	**2007Q1**	**2013Q1**	**–52.2**
Italy	1973Q3	1981Q2	109.1	1981Q2	1986Q2	–36.1
	1986Q2	1991Q4	60.0	1991Q4	1997Q3	–28.4
	1997Q3	2008Q1	59.8			
Japan	1970Q1	1973Q4	55.0	1973Q4	1977Q3	–29.3
	1977Q3	1991Q1	82.6	**1991Q1**	**2009Q2**	**–44.8**
Korea[3]	1987Q2	1990Q4	32.6	1990Q4	2001Q1	–55.2
	2001Q1	2008Q3	39.0			
Netherlands	1970Q1	1978Q2	95.1	1978Q2	1985Q1	–49.9
	1985Q1	1990Q2	22.4			
	1992Q2	2007Q4	166.9	**2007Q4**	**2014Q1**	**–25.4**
New Zealand	1970Q1	1974Q3	72.7	1974Q3	1980Q2	–40.7
	1980Q2	1984Q2	34.2			
	1992Q1	1997Q2	43.6			
	2000Q4	2007Q3	100.4	2007Q3	2009Q1	–15.1

Country	Upturns			Downturns		
	Start	End	Price change[2]	Start	End	Price change[2]
Norway	1983Q4	1987Q2	58.3	**1987Q2**	**1993Q1**	**–40.1**
Portugal[3]	1988Q1	1992Q2	23.6			
	1996Q3	2001Q2	16.0	2001Q2	2013Q2	–33.3
Spain	1972Q2	1974Q3	31.1			
	1976Q2	1978Q2	27.9	**1978Q2**	**1982Q2**	**–35.1**
	1982Q2	1991Q4	145.4	1991Q4	1996Q3	–18.4
	1996Q3	2007Q3	140.3	**2007Q3**	**2013Q2**	**–42.7**
Sweden	1974Q2	1979Q1	24.5	1979Q1	1985Q3	–35.2
	1985Q3	1990Q1	41.0	**1990Q1**	**1995Q4**	**–30.8**
Switzerland	1970Q1	1973Q1	30.8	1973Q1	1976Q3	–29.0
	1976Q3	1989Q4	72.8	1989Q4	2001Q2	–37.7
	2001Q2	2016Q3	57.0			
United Kingdom	1970Q1	1973Q3	68.5	1973Q3	1977Q2	–35.1
	1977Q2	1980Q3	27.2			
	1982Q1	1989Q3	103.8	1989Q3	1996Q2	–27.6
	1996Q2	2007Q4	183.0	**2007Q4**	**2013Q1**	**–21.1**
United States	1970Q1	1973Q4	15.5			
	1975Q3	1979Q1	19.8			
	1993Q1	2006Q4	64.0	**2006Q4**	**2012Q1**	**–27.4**

Note: In bold, downturns coinciding with a systemic banking crisis, as identified in Laeven and Valencia (2008, 2012).

1. Major cycles are defined as cycles where the change in housing prices during a cycle phase (upturn or downturn) is at least 15%.
2. Percentage change in real housing prices, adjusted using the private consumption deflator.
3. The period covered starts in 1986 for Korea and 1988 for Portugal.

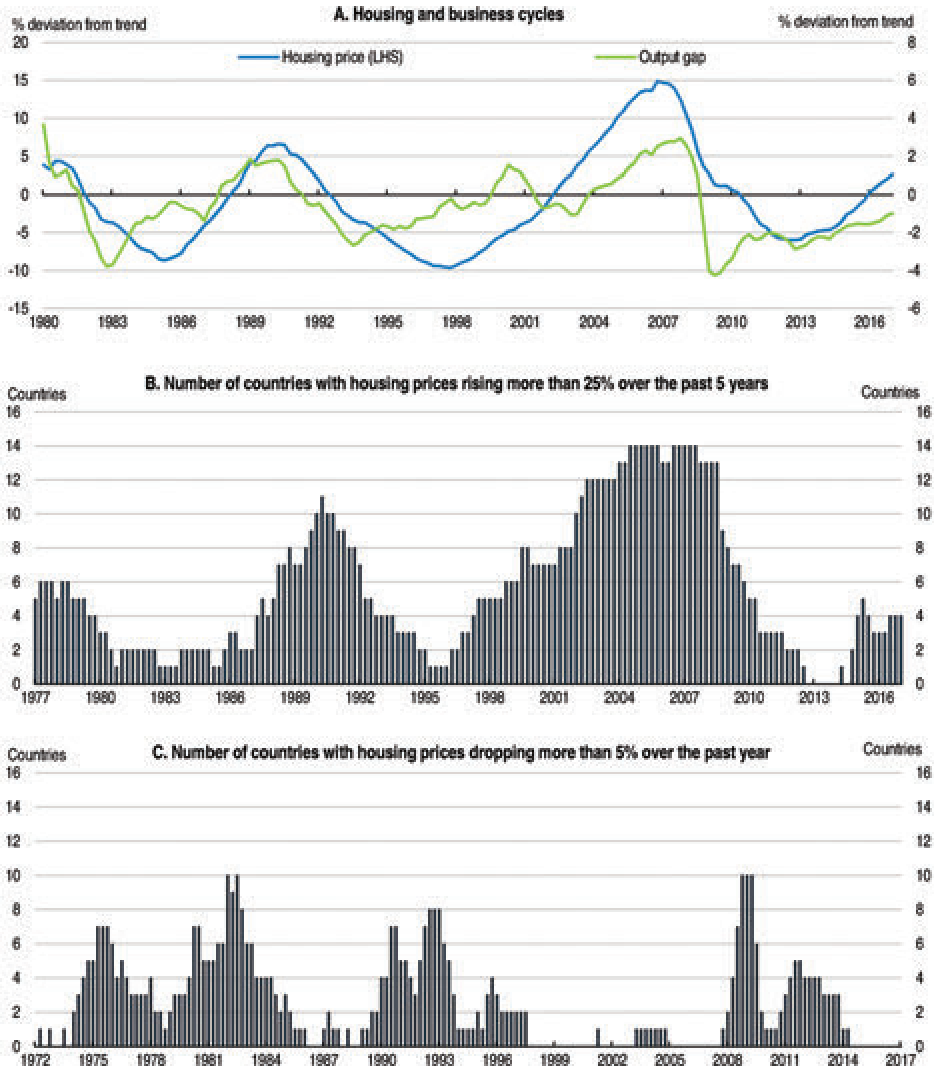
Source: OECD Analytical house prices database.

The amplitude of the global housing cycle which peaked around the GFC was also remarkable, with real housing prices more than doubling on average, before dropping by a third. While price-to-rent and price-to-income ratios typically peak at 10 to 15% above their long-term average, they were more than 30% above these levels on average when the GFC hit, and even exceeded 50% in Denmark, Ireland and Spain. The contraction in real GDP and private consumption during the downturn was deeper and more protracted than in other recessions associated with real estate slumps, and real residential investment collapsed (Figure 2).

Real housing prices are now rising in most OECD countries, with the exception of Italy, where prices have been falling almost continuously since early 2008. Nevertheless, in about a third of the sample prices are still well below their pre-crisis levels (Denmark, Spain, Ireland, the Netherlands, Portugal and the United

States). Housing price increases as of the beginning of 2017 remain relatively modest in most countries. Nevertheless, renewed concerns emerge about inflated housing prices in Australia, Canada, Norway, and Sweden, where a more than twenty-year growth period was barely interrupted by the GFC, and in New Zealand and the United Kingdom, where prices have bounced back strongly after the crisis.

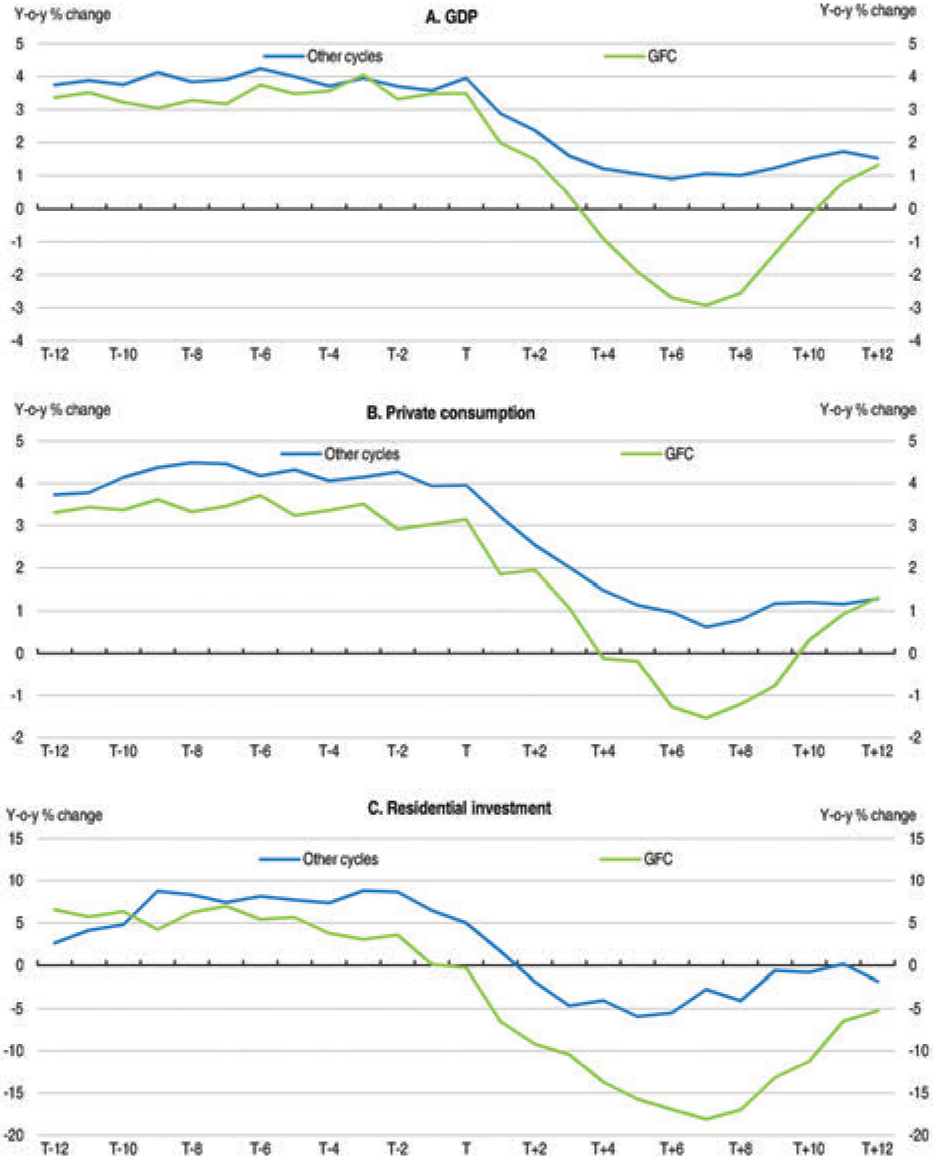
Figure 1. Synchronization of housing price cycles



Note: The sample covers 18 OECD countries for which housing price data are available since the early 1970s. The housing price trend used in Panel A is a linear trend.

Source: OECD Analytical house prices and Economic Outlook databases.

Figure 2. Main macroeconomic aggregate around cycle peaks



Note: T corresponds to the quarter of the housing prices cycle peak. GFC refers to the cycle with a peak between 2006Q4 and 2008Q3 depending on the country; Other cycles refer to all the other major cycles (defined as those where housing prices decline by at least 15%) identified since 1970. The numbers are averages over countries at the same point of the cycle.

Source: OECD Analytical house prices and Economic Outlook databases.

2. Real estate and financial crises: an historical overview

Speculation in land and real estate can be traced back far in history. It was reported in the Netherlands in the seventeenth century, in Britain in the eighteenth, in Australia, France, Germany, Norway and the United States in the nineteenth (Kindleberger and Aliber, 2005; Brunnermeier and Schnabel, 2015). A land-price bubble in Florida was part of the euphoria which preceded the Great Depression, although it burst as early as 1926 (Galbraith, 1961). No major financial crisis related to real estate was recorded in advanced economies during the period between the Second World War and the early 1970s. The period which followed the collapse of the Bretton Woods system in 1971 saw a resurgence in financial instability. Real estate played an important role in a series of financial crises which hit advanced and emerging economies, in particular the Spanish banking crisis of the late 1970s, the US Savings and Loans crisis of the late 1980s, the Japanese and Nordic meltdowns of the 1990s, the Asian crisis of 1997 and the 2007 US subprime crisis and the global financial and economic crisis which ensued. These events are very disparate with respect to their causes, economic and social consequences and resolution. Nevertheless, they feature some common characteristics, notably rapid credit growth, large foreign capital inflows, as well as financial deregulation and innovations.

2.1. The Spanish banking crisis of the 1970s

Spain went through a serious banking crisis starting in 1976, in which the collapse of the real estate market played an important role. The banking crisis had its roots in financial deregulation and ineffective banking supervision. In 1974, commercial banks were allowed to expand beyond their traditional geographical limits and open branches across the country. Interest rates on loans and deposits of more than two years were liberalized (Salas and Saurina, 2003). Deregulation led to intense competition for market share between banks which were not accustomed to operating in a competitive environment and were not adequately regulated and supervised (Betrán and Pons, 2017). Low real interest rates contributed to fueling credit growth in the 1970s. Following the first oil shock, the performance of the Spanish economy deteriorated and external imbalances built up, which eventually led to a currency crisis which required International Monetary Fund (IMF) support in 1975–76. Real housing prices peaked in the second quarter of 1978, and subsequently fell by more than 35% before bottoming out in the second quarter of

1982. Residential investment contracted by more than 10% over the same period. GDP continued to grow, but at a much slower pace than previously. Banks were heavily exposed to real estate through both mortgages and loans to real estate developers. They also held large portfolio of industrial equities, which weakened their balance sheets further when the stock market collapsed. More than fifty banks were liquidated, merged or nationalized, accounting for almost half of the banks and 20% of deposits (Martin-Aceña, 2013). Savings banks were much less affected by the crisis than commercial banks, as they had remained tightly regulated in the run-up to the crisis. Their deregulation in 1977 would eventually lead to their difficulties in the late 2000s (Martin-Aceña, 2013). Estimates of the fiscal cost of the late 1970s crisis range between 5.6% and 16.8% of GDP (Reinhart and Rogoff, 2013)[5].

2.2. The US Savings and Loans crisis

Savings and Loans (S&Ls), whose history goes back to the nineteenth century, are financial institutions which essentially use short-term deposits to fund long-term amortizing mortgages with fixed interest rates. Many of them were already experiencing serious difficulties in the 1970s, as rising inflation was making their asset and liability maturity mismatch problematic. Their deposit base was eroded as regulation imposed interest rate caps on their deposits, while competitors, notably money market funds, could offer higher returns. At the same time, inflation was pushing long-term nominal interest rates up, thereby reducing the value of their fixed-rate mortgage portfolios.

The S&L crisis was not primarily caused by a real estate crash and had limited macroeconomic impact (Field, 2017). Nevertheless, it is worth describing for a number of reasons. First, it is a major financial crisis if measured by the number of institutions which failed – more than a thousand – and its fiscal cost – between 2.4% and 3.2% of GDP (Reinhart and Rogoff, 2013). Second, commercial real estate played a major role in the failure of some S&Ls. Third, financial deregulation was a key factor, as in later crises around the world. In particular, institutions similar to the S&Ls in other countries experienced distress following deregulation

5 The fiscal costs of financial crises mentioned in this paper refer to the net cost of public support to financial institutions. Estimates from the literature generally vary due to differences in methodology and the time when they were made, as some amounts may take a long time to recover, for instance when bank shares are sold by the government or assets are sold by asset management companies several years after the crisis. Obviously, the impact of financial crises on public finances goes far beyond the costs of rescuing financial institutions, in particular because of revenue losses and increased social spending due to weaker activity and lower employment.

(*e.g.,* Finland, Spain). Fourth, the crisis profoundly transformed US housing finance, where S&Ls were major players. Finally, the Resolution Trust Corporation (RTC) was a precursor to the "bad banks" used in the resolution of many subsequent crises around the world.

In the early 1980s, deregulation removed interest caps and allowed S&Ls to widely diversify their activities and invest in a wide range of assets. The promoters of deregulation believed it would help S&Ls overcome their difficulties. Instead, their financial situation worsened. The abolition of the interest rate caps allowed attracting more deposits, but at an increasing cost, which weighed on S&Ls financial results and pushed many of them to take more risks. S&Ls, which used to specialize in residential real estate lending, were not well equipped for managing more complex risks involved in commercial lending and investment activities. Moreover, while the early 1980s legislative changes allowed S&Ls to engage in a wide range of commercial banking activities, they were not regulated by the same authorities as commercial banks. Regulatory forbearance allowed insolvent S&Ls to carry on with their activities. These "zombie" S&Ls with little equity had strong incentives to take high risks to improve their situation, as they had little to lose. The problem was exacerbated by two other regulatory changes, which increased the ability of "zombie" S&Ls to retain or increase their deposits. First, the deposit insurance ceiling was raised from USD 40,000 to USD 100,000 in 1980. Second, a 5% limit on the ratio of brokered to total deposits was lifted in 1982. Many S&Ls engaged in risky activities including speculation on land, commercial real estate and junk bonds. Fraud was also rife, as is often the case in the run up to financial crises. In sum, what had started as a crisis mainly triggered by the materialization of interest rate risk turned into a debacle due to poor loan underwriting, bad investments and fraud.

S&Ls and commercial banks invested massively in commercial real estate during the 1980s. The commercial real estate boom had some roots in fundamentals, with low vacancy rates in the early 1980s, resulting from rising demand for commercial space fueled by the expansion of service activities while supply was limited, as building activity had been subdued in the late 1970s. However, the boom was magnified by the boost to credit availability arising from financial deregulation, changes in taxation making investment in commercial real estate very advantageous and optimism about commercial real estate returns, which had outperformed equities and bonds over the preceding years. Commercial construction volume soared by more than 50% between 1983 and 1985 (Browne and Case, 1992; Geltner, 2013). National commercial real estate price increases were not impressive, especially compared to later booms. Real prices peaked in the second quarter of 1982 about

12% above their level five years earlier. The subsequent fall was nevertheless deep and protracted. Real prices bottomed out in the third quarter of 1996 nearly 40% below their peak level. The collapse in commercial real estate prices was a major cause of failure for commercial banks and especially S&Ls. Investments in junk bonds coupled with fraudulent practices also caused the failure of a number of S&Ls (Kindleberger and Aliber, 2005). However, junk bond investments were concentrated in 11 big S&Ls and on the whole were not a major cause of the S&L debacle (Field, 2017).

To address the crisis, Congress passed the Financial Institutions Reform, Recovery, and Enforcement Act (FIRREA) in 1989, which thoroughly transformed the regulation and supervision of S&Ls and created the Resolution Trust Corporation (RTC) to manage and resolve failed institutions and dispose of their assets. The RTC ceased operations at the end of 1995, having achieved a recovery rate close to 80% (Bergstresser and Peiser, 2014). Contrary to most other banking crises, the S&L debacle had only minor macroeconomic repercussions. It played only a very modest role in the 1991 recession, which in any case was relatively mild. The S&L crisis profoundly modified the structure of mortgage finance in the United States. By the mid-1990s, the share of mortgages held by depository institutions had fallen to about 30% from about 70% before the crisis and securitized mortgages had become predominant (Schnure, 2005).

2.3. The Japanese asset price bubble

Japan experienced a boom in equity and property prices in the second half of the 1980s, followed by a long period of economic stagnation after the bubble eventually burst in 1991. The Nikkei 225 stock index peaked in December 1989, after roughly trebling over four years. Real urban land prices jumped 38% in the five years to an early 1991 peak. The boom was fueled by rapid credit expansion. Monetary policy was accommodative, as the Bank of Japan overestimated potential output (Posen, 2003) and interventions in the foreign exchange market to moderate the appreciation of the yen inflated money supply (Kindleberger and Aliber, 2005). As in many other asset price bubbles, financial deregulation played a key role. As a result of the liberalization of securities markets, large firms gained access to market financing and reduced their demand for bank loans. This pushed banks to expand other business, notably lending to small and medium enterprises, which often use land and real estate as collateral. Banks were also exposed to real estate through the housing loan corporations (*jusen*) they had established, which were increasingly lending to real estate developers, a high-risk area in which they had little expertise (Nakaso, 2001). Moreover, deregulation allowed banks to increase direct lending for real estate, which had previously been tightly controlled.

Credit swelled and real estate prices and investment in construction soared, as well as equity prices, which were benefiting from the general economic euphoria and from purchases by foreign investors, notably global equity funds, which hoped to benefit both from the rise in equity prices and from the appreciation of the yen. Japanese banks had large holdings of real estate and equity on their balance sheets. Hence, their capital was increasing with the value of these assets, which permitted a further expansion of credit, in turn feeding further increases in asset prices. Similarly, rising property values were lifting the value of the collateral which borrowers could use to get additional loans. Inflated equity and real estate values also artificially strengthened the balance sheets of non-financial firms, which held large amounts of these assets. As rent increases were much slower than for real estate prices, many investors ended up with lower revenue than their interest costs, which they had to finance through new credits, a manifestation of Ponzi finance in Minsky's (1986) typology.

When, in late 1989, the Bank of Japan restricted the increase in bank real estate lending to the growth rate of their total loan portfolio, the sharp deceleration in real estate credit brought many investors into trouble, which triggered fire sales. In early 1990, equity prices collapsed. By August 1992, the Nikkei 225 stock index had lost more than 60% of its value relative to its end-1989 peak. Urban land prices started a long period of decline. By 2000, they had fallen by more than 25% and by 2017 by more than 60% in nominal terms. The *jusen* suffered heavy losses, which were partially covered by public funds. The asset price collapse was followed by a sharp deceleration in real GDP growth, which averaged about 1% from 1990 to 2016 compared to 4.5% between 1970 and 1990. The deceleration is spectacular, even when considering that growth would have inevitably been slowed by Japan's catch-up with the most advanced economies and the ageing of its population. Japan also experienced deflation, as measured by a fall in consumer prices, in most years between 1999 and 2012. Although recessions associated with collapses in real estate prices and banking crises usually last longer than other recessions (Reinhart and Rogoff, 2013), the duration of the Japanese downturn has been exceptional.

Several explanations have been put forward for the dismal performance of the Japanese economy in the post-crisis period. Monetary policy was slow to react after the bubble burst (Bernanke, 2000). Fiscal tightening, along with the Asian financial crisis, may have contributed to halt an incipient recovery in 1997 (Posen, 2003). Nevertheless, the most important explanation for protracted stagnation is probably the failure to restructure the banking system. Japanese banks, supported by regulatory forbearance, continued lending to "zombie" firms, hampering economic restructuring and the emergence of more productive businesses (Posen, 2003, Hoshi and Kashyap, 2004). It was not until 1998, after the failure of several large financial institutions, that decisive action was taken to restore the stability of the banking system, notably the recapitalization of weak but viable banks, the temporary nationalization of non-viable ones, the requirement of better recognition of non-performing loans and the establishment of new asset management companies to restructure corporate debt (Fujii and Kawai, 2010). Estimates of the fiscal cost of the financial rescue range between 8% and 24% of GDP (Reinhart and Rogoff, 2013). More importantly, growth remains sluggish to this day and Japan is only slowly emerging from deflation despite massive monetary stimulus.

2.4. The Nordic banking crisis

Almost at the same time as in Japan, real estate and equity price booms occurred in Finland, Norway and Sweden. The drivers of the crises were broadly similar in the three countries, with sizeable capital inflows intermediated by the banking system and financial deregulation playing a central role. Before the 1980s, the banking sector was tightly regulated in the three countries, with in particular restrictions on international capital flows, lending ceilings, interest rate caps and other constraints on asset allocation. Financial deregulation in the mid-1980s resulted in rapid credit growth, as financial institutions competed to gain market share. Institutions accustomed to operating in a heavily regulated environment had limited experience of risk management in a liberalized financial system. Similarly, prudential regulation and supervision was not upgraded to adjust to the new environment. Furthermore, the tax systems of the three countries allowed deducting interest expenses from taxable income subject to high marginal rates, resulting in often negative after-tax interest rates (Englund, 1999). This contributed to boosting credit growth once quantitative restrictions on credit were lifted. At its peak, annual nominal lending growth exceeded 30% in Norway and Sweden and 40% in Finland. Real housing prices rose by 41% in Sweden, 58% in Norway and 66% in Finland in the second half of the 1980s. Over the housing price boom period, increases in residential investment were modest in Norway and Sweden, but exceeded 50% in Finland. The increase in commercial real estate construction was generally limited. Even in Stockholm, where real office prices were increasing at an annual rate of around 20% during the boom, office space only increased by slightly over 8% between 1985 and 1990 (Englund, 2015). The fall in oil prices in 1986 halted the boom in Norway, which is a major oil producer, but stimulated the Finnish and Swedish economies further through terms of trade gains. The prolongation of the boom explains to some extent the more severe subsequent economic contraction in these two countries than in Norway, where real housing prices peaked in the second quarter of 1987.

In Sweden, the stock market peaked in August 1989 and signs of excessive supply of commercial property appeared during the following autumn. Real housing prices peaked in the first quarter of 1990. After a financial company highly exposed to real estate (Nyckeln) experienced refinancing difficulties in September 1990, the crisis spread to the money market and then to the banks. The latter accumulated heavy losses, especially on real estate-related loans, which accounted for 40% to 50% of total bank losses over the period 1990–93, while their share of loans was only 10 to 15% (Englund, 1999). Two major banks (Första Sparbanken and Nordbanken) experienced severe trouble in the autumn of 1991 and the fourth largest commercial bank of the country (Gota Bank) went bankrupt in September 1992. In Finland, the savings banks, which traditionally focused on housing and real estate lending, suffered the most. Savings banks formed a network of numerous (254 in 1985) formally independent banks, with a central institution, Skopbank, providing them liquidity and specialized services. Savings banks were generally very small and their profitability was low due to high costs. After deregulation, fast lending growth was seen as a way to improve profitability. Between 1986 and 1990, aggregate Skopbank and savings banks lending increased by 140%, compared to less than 80% for commercial banks (Englund and Vihriälä, 2003). The expansion of savings banks implied entry into new business areas and increased risk-taking. In September 1991, after the crisis hit, Skopbank suffered an acute liquidity shortage and was taken over by the Bank of Finland. In Norway, where the crisis started earlier than in Finland and Sweden, a few local and regional banks experienced troubles between 1988 and 1990, in most cases resolved by merging failing institutions with stronger banks. But as the crisis deepened in 1991, the three biggest commercial banks (Christiania Bank, Fokus Bank and Den Norske Bank) were hit and eventually had to be nationalized (Vale, 2004).

The economic crisis in the Nordics was exacerbated by the sharp rise in interest rates following the German reunification and speculative attacks against fixed exchange rate parities. After the crisis of the European exchange rate mechanism, the three countries unsuccessfully tried to defend their exchange rate parities. Interest rate shot up. In September 1992, the Swedish overnight rate peaked at 500%. Eventually, the three currencies were left to float. Currency depreciations weighed on the balance sheet of firms indebted in foreign currencies, but allowed interest rates to come down and paved the way for a strong export-led recovery.

Changes in the tax system in Norway and Sweden also contributed to raise after-tax interest rate during the crisis. In Sweden from 1991 and Norway from 1992, the marginal tax rate at which interest could be deducted from income tax was reduced sharply. Although this was a sensible move reducing excessive incentives towards borrowing, its timing was unfortunate, as it came into force when interest rates were rising and the economy and housing market collapsing. The recession was severe, with a cumulative fall in GDP of more than 4% in Sweden and nearly 10% in Finland between 1990 and 1993. The recession was deepest in Finland, as it simultaneously suffered from the financial crisis and a steep fall in exports associated with the collapse of the Soviet Union. Real housing prices bottomed out in the first half of 1993 in Finland and Norway, more than 40% below their previous peak. In Sweden, they declined until the last quarter of 1995, when losses amounted to more than 30%.

Given the magnitude of the crisis, the recovery was fairly rapid in all three countries and was followed by a long expansion. The banking sector was successfully restructured following the same general principle of saving the banks but not their owners (Englund, 1999). Only in a limited number of cases did the shareholders of failed banks recover some of their capital. Conversely, a blanket creditor guarantee was issued in Finland and Sweden, but no formal guarantee was given in Norway, although the government stated it would intervene if necessary to safeguard confidence in the banking system (Sandal, 2004). Sweden and Finland also established asset management companies, or "bad banks", while Norway did not, although similar structures were set up within some banks. In Sweden, the non-performing loans of Nordbanken (over 20% of total assets) and Gota bank (over 45% of total assets) were transferred to "bad banks" (Ingves and Lind, 1996). Both banks were recapitalized and Nordbanken eventually took over Gota Bank, which did not look viable on its own. Nordbanken, in which the Swedish state owned a majority of shares already before the crisis, later became part of the banking group Nordea. In Finland, asset management companies were established to dispose of the non-performing assets of Skopbank and savings banks, and most banks were recapitalized. The savings bank sector was downscaled, first by merging forty one savings banks into the Savings Bank of Finland and subsequently splitting the latter into four parts to be sold out to competitors. Similarly, in Norway, where the three main banks had been nationalized, emphasis was put on measures to cut costs and restore profitability (Sandal, 2004). In the three countries, banks returned to profitability relatively rapidly. Those that were in public ownership could be gradually privatized and most of them joined large Nordic banking groups, which have been pretty successful since then and in particular withstood the 2008 global financial crisis well. The resolute restructuring of the banking system paved the way for a solid economic recovery from 1993 onwards. The credit crunch which could have resulted from the financial turmoil was largely avoided (Vihriälä, 1997; Englund, 1999; Steigum, 2004). Restored competitiveness after the currency depreciations boosted exports. The recovery was buttressed by changes in macroeconomic management and structural reforms, which supported a sustained expansion. In turn, the expansion allowed the recovery of much of the public funds used to bail out the financial system, especially in Norway and Sweden, where plausible estimates put net fiscal costs close to zero[6]. In Finland, even though recoveries on assets were fairly large, the net fiscal cost estimates remain relatively high, at around 5% of GDP (Sandal, 2004; Honkapohja, 2009).

2.5. The Asian financial crisis

The Asian financial crisis started in Thailand in July 1997 and rapidly propagated through the region. In the early 1990s, the appreciation of the yen eroded the competitiveness of Japanese firms, pushing many of them to relocate manufacturing activities in South East Asia, particularly Malaysia and Thailand, to benefit from low labor costs. Many US, European and other Asian companies did the same. Meanwhile, capital account liberalization and financial market deregulation, coupled with optimistic growth expectations, led to an expansion of credit and further capital inflows. A large part of borrowing was short-term, in foreign currency and intermediated by local banks. The region's economy boomed and equity prices skyrocketed, peaking around 1997 on average at 165% above their value at the start of the decade (Collyns and Senhadji, 2002). Easy access to capital, excessive optimism and competition between lenders to gain market share in newly deregulated markets fueled domestic credit growth. Banks lacked risk-management expertise in a competitive environment and financial regulation and supervision was inadequate (Mishkin, 1999). The close relationships between banks and non-financial corporations also supported lending without sufficient consideration for risks (Lindgren *et al.*, 1999). Excessive business investment, often encouraged by government policies, led to low profitability of new investment projects. The boom generated large current account deficits, reaching a peak relative to GDP of around 3% in Indonesia, 4% in Korea, 8% in Thailand and 9% in Malaysia. It was

6 Reinhart and Rogoff (2013) report somewhat higher costs: between 2% and 4% of GDP for Norway and between 3.6% and 6.4% of GDP for Sweden. Englund (1999) reports a cost of about 2% of GDP for Sweden.

increasingly evident that the currencies of the region, which were *de facto* pegged to the US dollar, were overvalued. The appreciation of the US dollar against major world currencies from 1995 and the fall in the price of semi-conductors eroded further the price competitiveness of East Asian economies (Corsetti *et al.*, 1999). The confidence of foreign creditors in Thailand was also shaken by the losses of finance companies, which were partly funded by foreign financial institutions, as well as local banks. The Thai Baht came under pressure and eventually depreciated by nearly 20% against the US dollar in July 1997. Sharp currency depreciations in many countries of the region followed. By the end of 1997, the currencies of the countries in crisis had lost between a third and half of their value against the US dollar, compared to end of June levels. Many bank failures followed and numerous non-financial corporations, which had borrowed heavily in foreign currencies, were also in trouble. Indonesia, Korea, the Philippines and Thailand had to request IMF support[7]. Strategies to deal with the crisis included liquidity support, blanket guarantees for depositors and most creditors, closure of non-viable financial institutions, recapitalization of weak but viable banks, bank mergers, temporary nationalization of some banks, the creation of asset management companies to deal with non-performing loans and other distressed assets, and measures to facilitate the restructuring of the non-financial corporate sector. The principle of writing off existing shareholders capital was generally applied. The ability of the financial system to function was progressively restored. Nevertheless, the countries of the region suffered from a credit crunch. Despite the intensity of the crisis, GDP bounced back relatively rapidly. By the last quarter of 1998, all the economies hit by the crisis were growing again, except Indonesia, which had to wait another quarter. Nevertheless, while Korea reached its pre-crisis peak in GDP per capita after just two years, it took five years in Thailand, six years in Malaysia and seven years in Indonesia. The net fiscal cost of financial restructuring ranged from about 20% of GDP in Korea, to around 35% of GDP in Thailand and more than 40% in Indonesia (Stevens, 2007).

Developments in real estate markets varied widely across the countries affected by the Asian crisis. While Thailand and Malaysia experienced property price bubbles and construction booms, the property market was fairly stable in Korea. Thai finance companies, non-bank financial institutions created partly to circumvent credit restrictions, invested massively in real estate and contributed strongly to the financial meltdown. Real estate played a lesser role in the crisis

7 The Philippines suffered from the contagion of the Asian crisis. However, capital outflows and financial and banking distress was limited (Lindgren *et al.*, 1999).

in Indonesia than in Malaysia and Thailand, even though overheating appeared in some market segments, such as the Jakarta office and condominium markets (Quigley, 2001). Korea had made a huge effort to remedy a large housing shortage in the late 1980s and early 1990s, resulting in a massive increase in supply and a fall in real housing prices. As a result, the Korean property market was broadly balanced in the mid-1990s and hence less vulnerable to a credit shock than other property markets in the region. At the end of 1997, bank exposure to real estate was in the 15–25% range in Korea, compared to 30–40% in Malaysia and Thailand (Corsetti *et al.*, 1999). Hong Kong and Singapore property prices increased rapidly in the first part of the 1990s before falling sharply and the local banks had at least as high exposures to real estate as in Malaysia and Thailand. Nevertheless, the Hong Kong and Singapore banks proved resilient to the crisis, largely because of solid risk management, regulation and supervision. In Indonesia, Malaysia and Thailand, there is evidence of underpricing of mortgage risk (Koh *et al.*, 2005)[8]. Inflated property appraisals also pushed up lending. Excessive property lending and investment manifested themselves in particular in high office and residential vacancy rates and non-performing real estate loans, even before the crisis hit (Quigley, 2001). The subsequent adjustment was large and protracted across the region, with real housing price falls of between about 20% and more than 50% over a period of three to seven years (Reinhart and Rogoff, 2013).

The Asian financial crisis was followed by a redirection of capital flows towards high income countries, especially the United States, which contributed to fuel the "dotcom bubble", the US stock market bubble led by technology shares, which burst in 2000. This episode was not accompanied by property market exuberance, but may have affected future real estate market developments in the United States and other countries in at least three ways. First, the collapse of equity prices may have reinforced the perception of real estate as a safe haven. Second, low interest rates in the wake of the bubble burst contributed to push up housing prices. Third, the relatively mild recession which followed the stock market crash may have reinforced the conviction of some policymakers, notably in the United States, that trying to prevent asset bubbles was not a priority, as it would be relatively easy to stabilize the economy after a bubble burst.

[8] More precisely, Koh *et al.* (2005) identify underpricing by financial intermediaries of the put option imbedded in non-recourse mortgage loans.

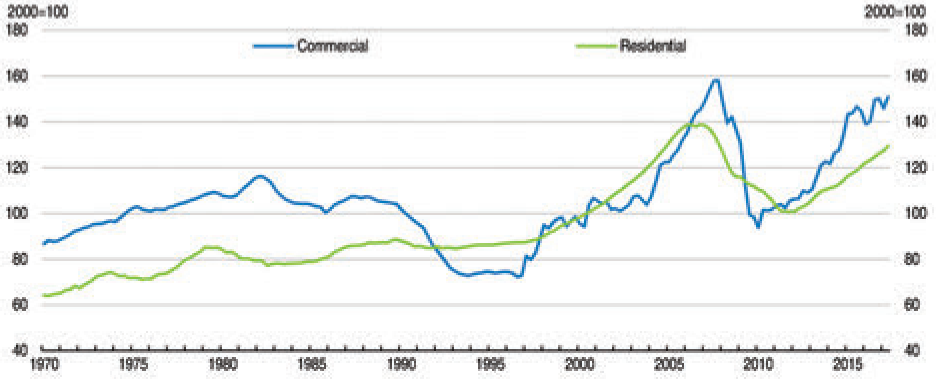
2.6. The global financial crisis and the Great Recession

The 2007 global financial crisis resulted in the Great Recession, the deepest global economic downturn since the Great Depression of the 1930s. Difficulties in housing and mortgage markets affected many countries, but in different ways. The meltdown of the US subprime mortgage market was at the epicenter of the crisis and exposure to real estate was a major source of financial distress in the United States and foreign institutions with large holdings of assets backed by US real estate. Several UK mortgage lenders failed essentially because of vulnerable funding models. In Ireland and Spain, massive building in the run-up to the crisis created excess housing supply, generating heavy losses for construction and real estate companies, to which the banking system was heavily exposed. As the recession deepened and unemployment increased, defaults on mortgages also started to rise in these countries. Foreign-currency mortgages were a major source of distress in some Central and Eastern Europe countries and Iceland, following large currency depreciations. Beyond these country-specific problems, the global housing boom-bust cycle amplified the economic cycle. In many counties, the increase in housing prices pushed up household consumption during the boom, through wealth and collateral effects (CBO, 2007; Skudelny, 2009). Indebtedness rose markedly, both to buy more expensive homes and for consumption (André, 2016). The housing bust and the financial and economic downturn led to a contraction in credit and consumption (Dynan, 2012; Mian *et al.*, 2013; Bunn, 2014; Lau Andersen *et al.*, 2014).

The US subprime crisis was at the origin of the GFC. While its mechanisms are unique, it features the usual ingredients of a financial crisis: large capital inflows, financial deregulation and innovations, deficiencies in supervision and fraud. The subprime mortgage market, which caters to borrowers unable to qualify for conventional loans because of poor credit history, insufficient guarantees or both, expanded considerably around the mid-2000s. At its peak, between 2004 and 2006, subprime market originations amounted to more than 500 billion dollars per year and around 20% of total mortgage originations. This expansion was accompanied by a marked loosening of underwriting standards. A variety of non-standard products were used to generate more business, including mortgages with teaser rates (low interest rates for a limited period), interest-only, negative amortization and flexible repayment loans. In the worst case, so-called NINJA (No Income, No Job, No Assets) loans were extended to households who could not certify an income or a job and had no assets which could have served to guarantee the repayment of the loan. Most subprime mortgages were securitized in an innovative way, creating complex and opaque financial structures with high leverage and maturity transformation.

A number of factors interacted to generate the subprime boom. First, a large part of the "savings glut" associated with the sizeable current account surpluses of some emerging economies, notably China, and oil and commodity exporters, was recycled in US financial markets (Bernanke, 2005). This pulled down long-term interest rates, triggered a search for yield which lowered risk premiums, and encouraged financial institutions to engineer supposedly safe assets, which were in high demand. Major European banks also invested massively in US asset-backed securities, largely financing themselves in the US money market (Noeth and Sengupta, 2012). Second, regulatory changes allowed a spectacular increase in bank leverage. In particular, a 2004 Securities and Exchange Commission ruling enabled investment banks to raise their leverage ratio from 15 to as high as 50 in some cases, which accelerated their loan purchases. The move towards the Basel II regulatory framework also provided opportunities for regulatory arbitrage, using off-balance sheet instruments. On the one hand, capital risk weights were lowered from 50% in Basel I to 35% in Basel II or even less if internal models were used to compute risk weights. On the other hand and contrary to Basel I, under Basel II capital requirements would apply to mortgages held off-balance sheet. Hence, in the period preceding the implementation of Basel II, financial institutions had an incentive to increase their leverage to the maximum allowed under Basel II by holding part of their assets off-balance sheet and there are indications that some have done so (Blundell-Wignall and Atkinson, 2008; Blundell-Wignall *et al.*, 2008). The removal of legal constraints on speculative trading in over-the-counter (OTC) derivatives through the 2000 Commodities Futures Modernization Act (CFMA) allowed a massive expansion of OTC derivatives, particularly credit default swaps (CDS), and an increase in leverage, which magnified financial losses during the crisis (Stout, 2011). Third, following accounting irregularities, in the mid-2000s higher capital requirements and balance sheet caps were imposed on the government-sponsored enterprises (GSEs) Fannie Mae and Freddy Mac, expanding opportunities for issuers of private-label mortgage backed securities. Government initiatives aimed at helping low-income families to obtain mortgages have also been widely blamed for fueling the subprime bubble. However, neither the Community Reinvestment Act, which imposes on depository institutions requirements to respond to the credit needs of their communities, nor the affordable housing goals of the GSEs, which require that a minimum share of the loans purchased by the GSEs is made of loans to low-income households or loans backed by properties in low-income communities, seem to have played a significant role in the subprime crisis (Avery and Brevoort, 2015). A parallel bubble in commercial real estate (Figure 3), where government involvement is almost absent, also casts doubt on the role of affordable housing policies in fueling the subprime bubble (Levitin and Wachter, 2013).

Figure 3. Real residential and commercial real estate prices in the United States



Note: Residential prices refer to the single family dwellings purchase and all-transactions index produced by the Federal Housing Finance Agency (FHFA). Commercial prices refer to an index of all US commercial properties from the US Federal Reserve. Both are adjusted using the private consumption deflator.

Source: OECD Analytical house prices database and Bank for International Settlements.

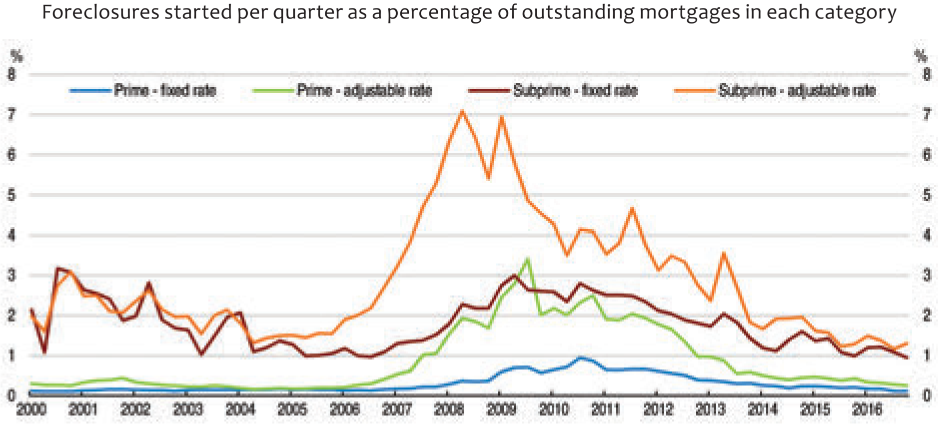
Contrary to the traditional securitization model of Fannie Mae and Freddy Mac, where loans are packaged into standardized mortgage-backed securities with guaranteed principal and interest payments, securitization of subprime loans involved structured financial products, where mortgage securities were sliced into tranches carrying different levels of risk. As the junior tranches would first bear potential losses, the senior tranches were considered safe investments. However, models used by banks, mortgage insurers and rating agencies, based on the short history of the subprime market, spanning a period characterized by rising housing prices, interest rates falling most of the time and mild economic conditions, underestimated risks considerably. Concentration risks and the impact of the loosening of credit standards during the boom were also largely ignored. Perverse incentives and conflicts of interest seem to have played a major role in the underestimation of risks. Securitization involves information asymmetry between different actors in the securitization process and the problem gets worse as the securities become more complex. Mortgage brokers and financial intermediaries could earn hefty fees by growing their business and transfer the risks to investors, which weakened underwriting standards. Credit rating agencies receiving fees from the issuers of the securities they rated were inclined to underestimate risks. Senior mortgage-backed securities tranches were often rated AAA, allowing them to meet the demands of institutional and foreign investors. Chains of securitization, with mortgage-backed securities pools financed through collateralized debt obligations (CDOs), sometimes themselves funded by CDOs (CDO-squared) increased the opacity of financial structures further. Compensation structures within financial institutions encouraged excessive risk taking and short-termism (Blundell-Wignall *et al.*, 2008). Fraud was also rife in the subprime market, including predatory lending, overstatement of borrower income, inflated property value appraisals, occupancy fraud (speculators pretending to be owner-occupiers), fraudulent flipping and provision of misleading financial information. The bubble in commercial real estate was also based on structured finance. From 2004, CDO packagers began to outbid experienced subordinated debt investors in the commercial mortgage-backed securities market, leading to a deterioration of underwriting standards and an increase in leverage (Levitin and Wachter, 2013).

While the subprime crisis triggered the GFC, it is not sufficient to explain its amplitude. Outstanding subprime loans amounted to about 1.3 trillion dollars at the time of the crisis, a still relatively modest amount relative to US and global financial markets. Total assets of the US banking system amounted to about 10 trillion dollars and US assets of European banks to about 8 trillion dollars. Losses on subprime loans were magnified by leverage, but the financial system also suffered from important structural vulnerabilities (Bernanke, 2010). Bubbles had built up in a number of areas, including private equity and commercial real estate. Low interest rates had led to a search for yield driving down risk premiums on a number of asset classes, ranging from equities to corporate and emerging market bonds (Kennedy and Sløk, 2005). Short-term wholesale financing of long-term illiquid investment was widespread, exposing financial institutions to sudden liquidity crises akin to old-style bank runs. Furthermore, a large part of these activities was taking place within the shadow banking system made up of financial intermediaries undertaking banking-type activities even though they were not regulated depository institutions, implying that they were not protected by access to a lender of last resort. Fragile and opaque financing structures were at the heart of the money market disruption, which crippled the financing system and drove the global economy into recession.

The subprime meltdown started in early 2007 and the financial crisis spilled over and intensified in stages. Housing prices had started to fall in some US States in late 2006, pushing up defaults on subprime loans. The subprime market, which essentially depended on rising housing prices, collapsed. Investors lost confidence in mortgage-backed securities, which were soon sharply downgraded by rating agencies. Defaults on subprime mortgages and foreclosures soared (Figure 4).

Real housing prices fell by more than a quarter between the end of 2006 and early 2012. By then nearly a third of mortgages were in negative equity. During the first half of 2007, several subprime mortgage underwriters went bankrupt. During the summer, the crisis intensified and spread internationally. In late July, the German bank IKB received public support to avoid bankruptcy, as its off-balance structured investment vehicle Rheinland Funding was no longer able to roll over its commercial paper to fund its large portfolio of US asset-backed securities. This was the first of a series of bailout of German regional banks, which later extended to Sachsen LB and West LB. In early August, the French bank BNP Paribas suspended withdrawals from three of its money market funds, as underlying assets had become virtually impossible to value. This pushed US Money market mutual funds to withdraw from the asset-backed securities market to avoid risking losses (White, 2009). The so-called TED spread, the difference between the 3-month LIBOR rate and the 3-month Treasury bill rate, which essentially reflects counterparty risk, jumped almost 200 basis points (Figure 5). A vicious circle developed, with falling and uncertain collateral values raising haircuts in repurchase agreements, thereby imposing fire sales which lowered further asset prices and collateral values (Bernanke, 2010; Mishkin, 2011).

Figure 4. Foreclosures in the US prime and subprime markets

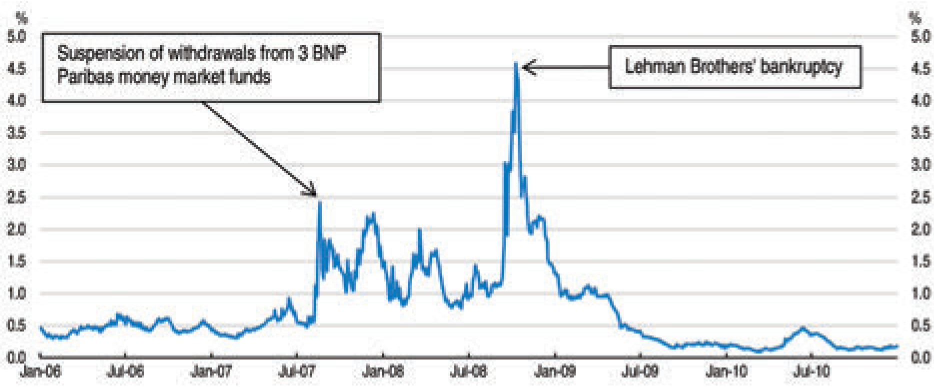


Source: Thomson Reuters Datastream.

In September, Northern Rock faced the first run on a British bank since 1866. Its loans had grown at an average annual rate of over 30% between 2001 and 2006 (Onado, 2009). It was heavily reliant on wholesale funding and when confidence in mortgage-backed securities vanished, it was unable to get funding and the government had to bail it out. Although Northern Rock was the most spectacular failure, the UK government had to provide further support to the banking system. Contrary to the United States, mortgage defaults remained relatively low in the United Kingdom throughout the downturn. It was through their funding model more than through the deterioration of the quality of their loans that UK mortgage lenders were vulnerable. The British banks had become increasingly reliant on wholesale funding. In 2001, lending by domestic UK banks to non-bank borrowers was comparable to domestic deposits. By 2008, the funding gap between retail deposits and lending had grown to an amount roughly equivalent to 50% of GDP, with almost half of it filled by interbank deposits from abroad (André, 2011).

Figure 5. The TED spread during the global financial crisis

Difference between the 3-month LIBOR rate and the 3-month Treasury bill rate



Source: Federal Reserve Bank of St. Louis.

Credit markets remained stretched during the rest of 2007 and early 2008. The US investment bank Bear Stearns, which was highly leveraged and exposed to mortgage-backed securities, collapsed in March 2008 and was taken over by JP Morgan Chase in an emergency deal brokered by the Federal Reserve. Fannie Mae and Freddy Mac came under government conservatorship in early September 2007. Nevertheless, at that point the situation still appeared manageable (Mishkin, 2011). But when the investment bank Lehman Brothers went bankrupt on September 15th, the crisis entered into another dimension. The reasons why the authorities abstained from bailing out Lehman Brothers and what would have happened if they had decided otherwise will certainly be discussed for years. But vulnerabilities in the financial system were obviously underestimated. In a situation of extreme uncertainty about the health of financial institutions, the realization by market participants that the authorities would not necessarily intervene to save failing institutions disrupted the money market. Over the following weeks, the TED spread jumped about 350 basis points (Figure 5). The day after the collapse of Lehman Brothers, the Federal Reserve had to grant a large loan to prevent the bankruptcy of the insurance company AIG, which had made huge losses on credit default swaps on subprime-related securities. Meanwhile, a major money market fund, the Reserve Primary Fund, which held a large amount of Lehman Brothers' securities "broke the buck", meaning that it could no longer redeem its shares at par value. Large withdrawals from money market funds followed, prompting the government to issue a temporary guarantee on money market funds to stop the run. The stock market collapsed, the S&P500 index tumbling about 40% over the two months following the failure of Lehman Brothers. The Federal Reserve vastly expanded its liquidity facilities to stabilize the markets. The Troubled Assets Relief Program (TARP) allocated an amount equivalent to about 5% of GDP to buy distressed securities, although because of difficulties in pricing these assets the program was in the end mostly used for bank recapitalization.

In the years preceding the GFC, many European banks borrowed heavily in the US money market and bought large amounts of US assets, in particular asset-backed securities. By mid-2008, foreign-bank liabilities, of which a large part from European banks, amounted to over 40% of US prime money market funds assets (Baba *et al.*, 2009)[9]. European banks expanded their balance sheets and leverage rapidly, by investing in assets carrying low risk weights under Basel II regulations. They also sponsored special purpose vehicles holding assets off-balance sheet. When the money market froze, many of them experienced liquidity problems. European central banks provided ample liquidity support and entered currency swap agreements with the Federal Reserve to inject dollar liquidity into their banking systems, as many banks needed dollar funding. But direct exposure to US financial markets was only part of the European banks' vulnerabilities. Kamin and DeMarco (2012) even argue that the direct role of the US subprime market in the international transmission of the crisis appears limited, as they find little evidence that countries with large holdings of US mortgage-backed securities and dependence on dollar funding suffered more intense financial distress than the others. European banks also held risky exposures to the euro area periphery, notably Ireland and Spain where property markets overheated. More fundamentally, the subprime crisis revealed the weaknesses of banking business models involving

[9] Prime money market funds refers to the funds investing predominantly in private securities, as opposed to those investing mostly in government securities.

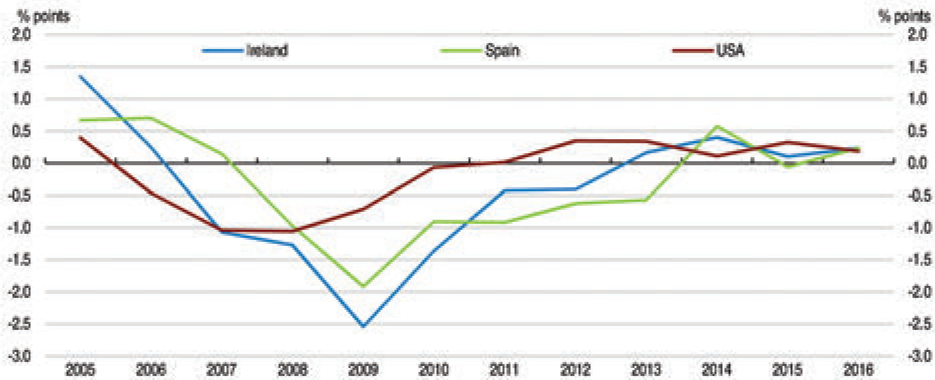
complex and opaque financial structures, high leverage, dependence of short-term funding, and poor risk management.

Many financial institutions suffered from solvency problems, which required further public intervention. We already mentioned the bailouts of Northern Rock and German regional banks, as early as the summer of 2007. After the Lehman Brothers bankruptcy, rescue operations were carried out on a large scale in the Autumn of 2008. To mention a few, public capital was injected into the British banks Lloyds (which had taken over struggling HBOS) and RBS, the Dutch group ING and the Swiss bank UBS, which was also allowed to transfer troubled assets to a new fund managed and predominantly funded by the Swiss National Bank. The governments of Belgium, France and Luxembourg recapitalized Dexia and those of the Benelux rescued Fortis, before selling its banking operations to the French bank BNP Paribas. The British government took over the mortgage business of Bradford and Bingley, while its branch network was sold to the Spanish group Santander. In 2010, the UK Asset Resolution (UKAR) holding was created to manage and wind down the mortgage portfolios of Northern Rock and Bradford and Bingley. The German Hypo Real Estate group, specialized in international commercial real estate finance, was nationalized in 2009 and its troubled assets, amounting to about 7% of GDP, were transferred to an asset management company (FMS) in 2010 (Medina Cas and Peresa, 2016). Bank recapitalization also occurred in countries whose financial systems suffered less from the GFC, including Austria (mainly because of exposure to Central and Eastern Europe), France and the Scandinavian countries (mainly because of exposure to the Baltic States).

By early 2009, financial conditions had started to normalize. The S&P500 stock market index bottomed out in March and money market conditions improved markedly, with the TED spread falling below 50 basis points in late May. But the real economy was badly hurt. Real GDP fell 2.8% in the United States, 4.4% in the euro area, 5.4% in Japan and 3.4% in the OECD as a whole in 2009. It took respectively 14, 29, 21 and 13 quarters for the United States, the euro area, Japan and the OECD to regain their pre-crisis GDP levels and corresponding unemployment rates peaked at respectively 9.9%, 12.1%, 5.4% and 8.5%. In countries where a construction boom had taken place in the run-up to the crisis, the fall in residential investment weighed heavily on GDP growth (Figure 6).

Housing market conditions in the wake of the GFC varied considerably across countries, depending both on pre-crisis developments and the resilience of the economy to the crisis. In some countries, like Australia, Canada, Norway and Sweden, housing prices declined after the GFC, but rebounded promptly, boosted by low interest rates and improving economic conditions. Housing prices started to increase in countries where they had been declining or stagnating before the crisis, like Austria, Germany and Switzerland. In other countries, particularly those where a housing bubble had developed before the GFC, the housing market recovery was protracted. The following paragraphs examine some of these cases in more detail.

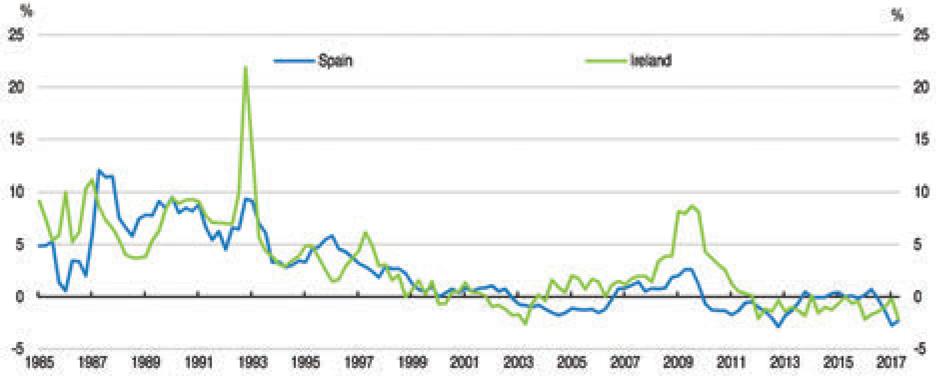
Figure 6. Contribution of residential investment to GDP growth



Source: OECD Economic Outlook database.

Ireland and Spain experienced exceptional housing price increases and construction booms starting respectively around 1995 and 2001. The fall in nominal interest rates associated with the convergence towards the euro increased the affordability of mortgages, releasing substantial pent-up demand. Interest rates even became negative in the mid-2000s, as inflation in Spain and Ireland was higher than the euro area average (Figure 7). In both countries, variable rate mortgages are predominant, lowering further the interest burden in the short term. Rapid household income growth, strong immigration, as well as purchases by foreigners in the case of Spain, also pushed up housing prices. As rising prices lowered affordability, financial innovation helped buyers obtain the loans allowing them to buy more expensive homes. The repayment period of mortgages was extended substantially in both countries, with 50-year loans becoming relatively common in Spain. Loan-to-value ratios could reach 100% (IMF, 2011). Between 1999 and 2007, real housing prices more than doubled. In Ireland, where the boom had started earlier than in Spain, real housing prices in 2007 were about three and a half times higher than in 1995. Residential investment soared, reaching about 12% of GDP, when the typical range in OECD countries is about 3% to 6%. Banks became heavily exposed to property developers and construction companies. The boom was in great part financed by foreign capital inflows, mirrored in current account deficits peaking at more than 9% of GDP in Ireland and more than 6% of GDP in Spain in 2007. Irish banks became especially dependent on foreign funding, including bank deposits by non-residents and bonds sold to foreign investors (O'Sullivan and Kennedy, 2010; Whelan, 2014). Spanish savings banks mainly financed their expansion through covered bonds or asset-backed securities, but maturities were generally medium to long term (Martin-Aceña, 2013; Banco de España, 2017). Financial supervision proved inadequate in both countries. The Spanish requirement for dynamic bank provisioning put in place in 2000 (Saurina, 2009) is likely to have mitigated credit losses during the downturn, but it was not sufficient to prevent the housing boom and the concentration of real estate exposures. Besides, savings banks, which since the late 1980s were allowed to compete with commercial banks nationwide, suffered from weak supervision and governance, notably related to interference from local and regional governments (Martin-Aceña, 2013; Betrán and Pons, 2017). Ireland had a "principles-based" supervisory framework and light regulation was part of a strategy to promote Dublin as an international financial center. Besides, after housing prices leveled off in 2001, the Irish government revived the boom by reinstating fiscal incentives for property development in remote areas, whose earlier abrogation, together with the global economic downturn, had contributed to rein in housing price growth (Whelan, 2014). A good opportunity to cool the property market and tame price expectations had been missed.

Figure 7. Real short-term interest rates[1]



1. 3-month money market rate. The short-term interest rate is shown as variable rate mortgages are prevalent in Ireland and Spain.

Source: OECD Economic Outlook database.

Although housing prices had already started falling in mid-2007, the Irish banking crisis really became acute after the fall of Lehman Brothers, which affected banks' foreign financing. At the end of September 2008, the government issued a blanket guarantee on Irish banks liabilities. Most of the banks were subsequently nationalized and recapitalized. Bank gross restructuring costs amounted to about 40% of GDP (Laeven and Valencia, 2012). The net long-term fiscal cost of bank recapitalization, although still very uncertain, was estimated at about 22% of GDP in 2015 (Honohan, 2015). The National Asset Management Agency (NAMA), established in late 2009, acquired 11,500 property development-related loans, with a nominal value of around 46% of GDP, at an average haircut of 58%. In October 2017, NAMA announced the full redemption of the government-guaranteed senior debt issued to acquire bank loans in 2010–11 and that it expected to return a surplus of 3 billion euros by 2020. Nevertheless, the cost of the banking sector bailout weighed heavily on public finances, which also suffered from the big drop in economic activity. In November 2010 the government had to apply for an ECB-EU-IMF rescue program, which imposed tough austerity measures. Real GDP fell cumulatively more than 8% in 2008–09 and the unemployment rate increased from below 5% in 2007 to more than 14% in 2012. As economic conditions deteriorated, mortgage defaults increased markedly, with the percentage of loans in arrears for more than 90 days peaking at more than 17% in late 2013. The number of foreclosures was contained and personal insolvency legislation was reformed in 2012 to facilitate orderly debt restructuring and resolution. Nevertheless, over-indebtedness remains a problem for many households (Honohan, 2016).

Major Spanish commercial banks were more solid than their Irish counterparts, partly thanks to better international diversification. But savings banks were fragile, particularly due to their high exposure to the real estate sector. Savings banks underwent vast restructuring and their number dropped from 45 in 2007 to just 2 at the end of 2012.[10] The recession and the euro area sovereign debt crisis weighed heavily on public finances. In June 2012, Spain had to apply for support from the European Financial Stability Facility (EFSF). This was followed by the set-up of SAREB (Sociedad de Gestión de Activos procedentes de la Reestructuración Bancaria) in July 2012 to remove distressed real estate assets from the balance sheets of troubled financial institutions. SAREB received nearly 200,000 assets amounting to about 5% of GDP, of which 80% were financial assets and 20% property. As the recession deepened, with real GDP contracting almost 9% between 2008 and

[10] Eleven survived as independent commercial banks and others were merged with other institutions (Betrán and Pons, 2017).

2013, and unemployment soaring to over a quarter of the labor force in 2013, the percentage of mortgages more than 90 days in arrears peaked at about 5%. More than 4% of mortgages ended in foreclosures between 2008 and 2013, a high share by European standards, although less than a third of the US percentage (Andritzky, 2014).

Between 2004 and 2008, Iceland experienced one of the most spectacular boom-bust cycles in history, which resulted in the collapse of its three largest banks within days in October 2008. The housing boom originated in a financing model which combined an impressive number of weaknesses, ranging from a rapid loosening of lending standards and weak financial regulation and supervision to large maturity and currency mismatches between bank assets and liabilities. Mortgage debt, which amounted to slightly over 100% of GDP at the peak of the housing boom, was only one area of vulnerability, with the total assets of the three major banks amounting to about ten times GDP in 2008 (Guðmundsson, 2012). The housing boom started when the recently privatized banks entered the mortgage market after it was deregulated in 2004. Loan-to-value and mortgage amount limits were progressively increased. With low interest rates, rapid economic growth and generous mortgage interest tax credits, demand for housing soared, pushing real prices up by more than 50% between August 2004 and October 2007 in the Reykjavik region (Skulason, 2012). Mortgage rates were generally linked to the consumer price index (CPI). From 2006 onwards, rising interest rates on loans in Icelandic krona led banks to increasingly offer mortgages linked to foreign currencies, notably the Japanese yen and the Swiss franc. As a result of foreign currency or CPI-indexation, the debt burden of households skyrocketed in 2008 when the krona depreciated by more than 50% in effective terms, pushing the inflation rate to about 17%. Nearly a quarter of homeowners had debt service exceeding 40% of their disposable income at the end of 2008. As housing prices declined, the share of homeowners in negative equity rose to close to 40% in 2010 (IMF, 2012).

The collapse of the three main banks compelled the government to establish new banks. Contrary to bank rescue operations in many other countries, where governments supported a large share of the losses, the Icelandic bank resolution left the creditors of the three major banks with heavy losses, amounting to 45 billion euros. Measures to provide relief to indebted households, taken under heavy social pressure on the government, included a temporary moratorium on foreclosures and a temporary freeze of debt service pending rescheduling of payments on CPI and exchange rate-linked mortgages. Bankruptcy law was also amended to allow earlier exit, which increased the negotiating power of debtors against creditors. In June 2010, the Supreme Court ruled that linking loans denominated in krona to exchange rates was illegal and the principal of the loans was cut to the original principal plus accrued interests. The loan reduction could amount to as much as 50%. As many households with CPI-indexed mortgages were still struggling, the government and financial authorities announced in December 2010 a plan to allow writing off mortgage debt exceeding 110% of the property value under specific conditions. Overall, household debt written off amounted to more than 12% of GDP at end-2011 (Skulason, 2012). Debt restructuring has undoubtedly helped the recovery of the Icelandic economy and the stabilization of the housing market.

After the fall of communism, mortgage lending expanded rapidly in Central and Eastern Europe, mainly as a result of the privatization of the housing stock, low interest rates, increased availability of credit and optimistic expectations about future income, which was anticipated to catch-up with the older EU members' levels. In some countries, foreign-currency mortgages became common, amounting to about 40% of outstanding loans in Poland, 70% in Hungary and 80% in Estonia in 2008, while their share was negligible in the Czech and Slovak Republics. The non-performing loan (NPL) ratios increased in all OECD Central and Eastern Europe countries during the crisis. The rise was relatively modest in the Czech and Slovak Republics and in Poland. On the contrary, NPL ratios of loans to households rose spectacularly in Hungary, reaching about 15% in 2012. Although this can be partly attributed to the depth of the recession and housing market structures, foreign-currency mortgages bore the main responsibility. After 2008, the sharp depreciation of the forint increased the loan repayment burden by 30% to 40% on average (Hegedus *et al.*, 2011). The Hungarian government launched a debt repayment program in September 2011, which allowed debtors to repay their mortgages at an exchange rate about 25% below the market rate during a period of about five months. Further measures to lock in preferential exchange rates for five years and to convert non-performing foreign-currency mortgages into forints were introduced. However, the impact of these relief programs on outstanding household debt has been modest. Relief schemes seem to have suffered from excessive complexity and poor targeting. In particular, only better-off households could afford to repay their loan in a single payment as proposed in the September 2011 program. Another weakness of the rescue programs was that two-thirds of the cost (of about 1.5 per cent of GDP in total) was borne by the banks, which had limited capacity to absorb it. This may have worsened the credit crunch (IMF, 2012 and 2013). Ultimately, in November 2014, the central bank and the Banking Association agreed to rapidly convert foreign-currency mortgages into forint, at the market exchange rate of the date of the decision, to reduce the exposure of households to exchange-rate risk (IMF, 2015).

To sum up, our overview of financial crises shows that real estate bubbles are often an important element, but neither a necessary nor a sufficient condition. Over the past decades, we have witnessed an exceptional recurrence of financial crises by historical standards (Bordo *et al.*, 2001; Kindleberger and Aliber, 2005). International capital flows, which amount to multiples of flows related to real activity, are prone to fuel unsustainable credit booms and asset price bubbles. Financial deregulation and innovation, often compounded by inadequate supervision of financial institutions, create vulnerabilities. Financial crises have been associated with various categories of investments, including sovereign and corporate loans and equities. Foreign capital inflows are often associated with current account imbalances (Reinhart and Rogoff, 2008; Obstfeld and Rogoff, 2009). However, current account imbalances mirror net capital inflows, but gross capital inflows sometimes also play an important role in fueling asset price bubbles (Borio and Disyatat, 2011). This is illustrated for example by the Japanese equity and property bubbles of the late 1980s, which coincided with current account surpluses. Another example where the focus on net capital flows is misleading is the role of European banks in the GFC, as they invested massively in US asset-backed securities using US money market funding. Capital flows often find their way to property markets, which feature characteristics making them prone to bubbles, as we will now show.

3. Mechanisms at play in a typical boom-bust real estate cycle

A fall in interest rate associated with an increase in credit supply often triggers a surge in housing demand, through a decline in the user cost of housing[11]. Housing demand is largely driven by potential buyers' ability to pay (Damen *et al.*, 2016). In turn, for most buyers, ability to pay is related to borrowing opportunities. Two characteristics of the relation between interest rates and borrowing capacity are worth reminding. First, nominal as well as real interest rates affect the ability to borrow, because high nominal rates imply a high initial repayment annuity. As banks generally set a limit for the repayment annuity as a percentage of the borrower's income, a higher nominal interest rate creates a tighter credit constraint, for a given level of real interest rate. Second, the relation between interest rate and borrowing capacity is non-linear. In other words a one percentage point decline

[11] The user cost of housing is determined by interest rates, actual and expected housing prices, depreciation, taxes, and maintenance costs (for more details, see Poterba, 1984).

in interest rate increases borrowing capacity much more at a low level of interest rate than at a high level. This feature is reinforced when combined with financial innovations, such as the lengthening of the repayment period or the increase in the maximum loan-to-value ratio. Hence, falling inflation and the related decline in nominal interest rates over recent decades, combined with financial innovations, have strongly contributed to increasing borrowing capacities, explaining the surge in housing demand. As the fall in interest rates is a global phenomenon and financial innovations have been widespread, they are likely to have contributed to increase the synchronization of housing price cycles across countries.

As borrowers are often credit constrained, increases in borrowing capacity tend to result in higher demand for housing, as some households will move from renting to home-ownership and others will buy more expensive homes. In some cases, there is substantial pent-up demand before a credit supply increase. For example, before the formation of the euro area, interest rates had been high for a long time in some future member states, constraining potential home buyers. Steep interest rate falls during the euro convergence process released large amounts of housing demand, which initiated a strong housing price upswing. A similar release of pent-up housing demand occurred with the expansion of the US subprime market, which gave access to home-ownership to new categories of households.

Housing supply is relatively inelastic in the short term, as it generally takes from a few months to several years to build new dwellings, taking into account the time to get building permission. Hence, increases in demand lead to higher prices. Furthermore, there is strong evidence that housing price expectations are to a great extent extrapolative. For example, on the basis of recent econometric estimates from several countries, Muellbauer (2012) argues that the rate of appreciation of housing prices over the past four years is a good proxy for the expected rate of housing price increase. Buyers may be expecting excessive housing price increases because they underestimate the response of supply, which comes with substantial delays (Shiller, 2008). Another factor which may amplify housing booms is the absence of short-selling. In asset markets where short-selling is possible, investors who think an asset is overvalued but do not own it can still sell it with delivery at a future date, thereby weighing on its price. Although the opportunity to sell short is generally not sufficient to prevent asset-price booms, because during periods of euphoria optimists will largely outweigh pessimists, it can still dampen run-ups in prices to some extent.

The combination of delayed supply response and extrapolative expectations can lead to hog-type (or cobweb) cycles. In this type of models, the amplitude of a cycle initiated by a demand shock depends on the price elasticity of supply. If the latter is low, the supply response is limited and prices stabilize rapidly at a higher level. Developments in the United Kingdom match fairly well this stylized model. If the price elasticity of supply is high, construction will overshoot, which will subsequently lead to large price falls, followed by a collapse in construction. The Irish and Spanish housing cycles conform quite well to this pattern. The supply response has implications for financial stability, as loans to highly leveraged real estate developers and construction companies tend to generate much more defaults than residential mortgages during downturns. Recent studies on the United States suggest that the most dramatic housing boom-bust cycles are likely to occur in areas with intermediate price elasticity of supply, where the long-run impact on prices of a demand shock is most difficult to anticipate (Gao *et al.*, 2015; Nathanson and Zwick, 2017).

As housing is a consumption but also an investment good, higher prices will not dissuade buyers who expect prices to continue rising. However, as rising prices lower affordability, they should face tightening financial constraints. But during booms, the latter tend to be eased through the financial accelerator and financial innovations. The financial accelerator amplifies credit cycles through a spiral between credit and collateral. As asset prices increase, the value of collateral borrowers can use to get new loans increases. Further borrowing allows further investments in assets, pushing prices further up, which provides more collateral and so on (Kiyotaki and Moore, 1997; Bernanke *et al.*, 1998). The Japanese bubble of the late 1980s illustrates this mechanism. In that case it was reinforced by the fact that banks held large amounts of equities and real estate on their balance sheets, which implied that the rise in the value of these assets increased bank capital and thus lending capacity. The expansion of lending to property developers backed by real estate collateral during the 2000s Irish housing boom provides another spectacular example of the operation of the financial accelerator (Carswell, 2011).

Financial innovation is often used to increase borrowing capacity, at the cost of higher risk both for borrowers and lenders. Mortgage repayment periods are often extended during booms. As mentioned earlier, 50-year mortgages were common during the 2000s boom in Spain and in the late 1980s, 100-year mortgages were introduced in Japan. Increasing maximum loan-to-value ratios (LTV) is another way to alleviate financial constraints. Before the GFC, many countries allowed LTVs as high as 100% and in a few cases even above (IMF, 2011). Since the crisis, much more stringent LTV limits have been applied in most countries (Whitehead and Williams, 2017). In periods of low interest rates, variable interest rate loans may also be used to lower costs, at least in the short term. For example, the expansion of the US subprime mortgage market pushed up the share of adjustable-rate mortgages

(ARM) from 10% of mortgage originations in 2001 to around 35% in 2004–06. The share of interest-only and negative amortization loans also soared between 2004 and 2006, to about a fourth of total mortgage originations (De Michelis, 2009). Interest-only mortgages were also used extensively in other countries and strategies for repaying the principal were often unclear. For example, in 2006 interest-only mortgages accounted for nearly 88% of new loans in the Netherlands, of which 44% were not associated with an investment product (Lunde *et al.*, 2008). The introduction of interest-only loans in 2003 was a major cause of the Danish housing bubble, which burst in 2007 (Dam *et al.*, 2011). As described above, Iceland and some Central and Eastern Europe banks abundantly used foreign currency mortgages before the GFC to take advantage of lower foreign interest rates, at the price of exposing borrowers to sizeable exchange rate risks. During the period preceding the GFC, low documentation loans became more common in many countries. Such loans, which have traditionally been granted to self-employed who could not document a steady stream of income, were increasingly extended to salaried workers, creating an incentive to overstate their income. For example, according to the UK Financial Services Authority incomes were not verified in the case of 49% of all UK regulated mortgage sales in 2007 (FSA, 2009). All the financial innovations we have just described helped fueling a number of housing booms. Some even more questionable commercial practices like teaser rates, or even fraudulent practices like inflated appraisals were also present in some cases.

While property price booms are typically ignited by fundamental factors such as strong income growth or interest rate falls, before being reinforced by extrapolative expectations and underestimation of risks, in their ultimate phase they tend to be amplified by speculators. Momentum traders who believe it is a good time to buy a dwelling because housing prices will rise further can have a sizeable effect on housing prices (Shiller, 2007; Piazzesi and Schneider, 2009). For example, Haughwout *et al.* (2011) find that in the US states where housing bubbles developed in the 2000s, investors accounted for almost half of purchase mortgage originations at the peak of the cycle. Investors have also played an important role in housing market developments in Australia (Yates, 2011).

Eventually the bubble bursts. The event which initiates the crash is often relatively minor in itself, for example it may be an unanticipated change in monetary or fiscal policy, a non-systemic financial institution suddenly facing difficulties or a financial crisis in another country. But it triggers a reversal of expectations. Investors realizing that their assets are overvalued start selling them, potentially initiating a downwards spiral of falling prices, financial distress and fire sales. The impact of a housing price collapse on the financial system and the economy depends on various factors. As shown in the first part of this chapter, housing price downturns are generally associated with a contraction in residential investment and a marked slowdown in private consumption growth. The contraction in investment is bound to be most severe where a construction boom has taken place, like Ireland, Spain or the United States in the 2000s. A high level of household debt is generally associated with a sharp adjustment of private consumption (Flodén, 2014). In many cases, a fall in housing prices does not trigger a financial crisis, even though it has a sizeable impact on the economy. Most recently, this has been illustrated by sharp housing price falls in Denmark and the Netherlands, which weighed heavily on private consumption, but did not cause many defaults on mortgages or serious trouble for financial institutions.

The meltdown of the US subprime mortgage market is fairly exceptional in having generated large losses from residential mortgages. As described above, this relates to exceptionally lax underwriting. In most crises, residential mortgage defaults are not the main cause of financial distress. Conversely, loans to real estate developers and construction companies are often a major cause of banking crises, as shown by the recent cases of Ireland and Spain. Funding structures with excessive leverage and maturity mismatch exacerbate the financial difficulties of financial institutions holding low-quality assets. But the failure of several mortgage lenders relying heavily on wholesale funding in the United Kingdom, where the increase in mortgage defaults has been very modest, suggests that the funding structure can in itself be a cause of bankruptcy.

The overview of major financial crises provided above also shows that although real estate booms are very often precursors to financial crises, they are most of the time accompanied by exuberance in other areas, like stock market speculation and corporate lending. Bank failures may lead to a credit crunch causing a deep economic recession. In the worst case, deflation can set in, pushing up the real value of debt and driving the economy into a depression, as happened in the United States in the 1930s (Fisher, 1933).

4. Policy responses: prevention and crisis management

The frequent coincidence of real estate busts with deep recessions and financial crises calls for preventive action. Although historical events always have their specificities, a number of features tend to be pervasive. A rapid expansion of credit is necessary to fuel a real estate bubble. Several factors may contribute, including excessively easy monetary policy, excessive leverage and destabilizing international capital flows. Financial deregulation is another common ingredient in housing booms. It may be useful to distinguish two different channels. First, deregulation may allow excessive risk taking. Failures in financial institutions which were allowed to extend their activity domain are recurrent. Savings banks are a case in point, with major failures in Finland, the United States and Spain at different points in time. The incursion of AIG in the CDS business is another example. Risk management is often inadequate when institutions move from heavily regulated and low-risk activities to more complex and risky business. Furthermore, deregulation will tend to increase the number of players in a market, intensifying competition for market share. In such an environment, turnover targets tend to dominate risk considerations. If one lender underprices risk, competitors will face the dilemma of either doing the same or losing market share. This makes prudential regulation and supervision all the more important in imposing sound standards and monitoring the evolution of risks. Unfortunately, in many episodes of financial deregulation, they were inadequate. The second potential impact of deregulation has more to do with the transition from a regulatory state to another. A loosening of regulation may allow a surge in lending, resulting in a large housing demand shock. As noted earlier, in the presence of delays in the housing supply response and extrapolative price expectations, this can initiate a bubble. Hence, the timing of deregulation is important. Loosening regulations in a strong upswing risks generating overheating. The case of Denmark in the early 1990s, which contrary to its Nordic neighbors avoided a financial crisis, is interesting in that respect. Denmark started to deregulate its financial system in the early 1980s, when the economy was weak. Furthermore, a tax reform reduced interest deductibility and prudential regulation and supervision were tightened (Honkapohja, 2009). The Danish case illustrates the importance of both the timing of reforms and of accompanying measures to enhance the resilience of the financial system.

The history of financial crises points to frequent deficiencies in the regulation of financial institutions, but also to the role of institutions subject to weaker rules than traditional financial institutions, such as the housing loan corporations (*jusen*) in Japan, the finance companies in Thailand or more recently shadow banks in advanced economies. Such institutions are often used to circumvent banking regulations and can contribute significantly to increase systemic risk. Hence, developments outside traditional financial institutions need to be monitored carefully. Financial innovation also features prominently in financial crises. New mortgage products can be developed to meet the evolving needs of borrowers or adapt to a changing financial environment. However, as shown earlier, they are often used to increase borrowing capacity in an unsustainable way during booms.

Enhancing consumer protection can mitigate this risk. Nevertheless, financial supervisors need to monitor underwriting standards closely and to tighten prudential rules if needed. For instance, tighter underwriting conditions for foreign-currency loans are imposed in Poland and mortgage amortization requirements were recently introduced in Sweden.

A major cause of financial crises is the procyclicality of the financial system. The Basel III framework introduces a countercyclical capital buffer, which can be complemented by macro-prudential measures imposed by national authorities. Targeted macro-prudential instruments, such as loan-to-value and debt-to-income caps on mortgages can help tame real estate booms (Cerutti *et al.*, 2015). The GFC has highlighted the vulnerability of the global financial system to liquidity crises. Even though the Basel III framework imposes higher liquidity buffers to banks, maturity mismatches between assets and liabilities need to be kept within reasonable limits. Sound macro-economic policy is also essential to prevent crises. Monetary policy has often been excessively expansionary during booms, even considering that it is a blunt tool to deal with asset bubbles. Similarly, fiscal policy has often been procyclical. Housing policies also have a role to play in crisis prevention, as some structural features of housing systems, such as a tax bias in favor of homeownership or chronic shortages of dwellings, while not causing bubbles in themselves, may amplify them. Overall, policymakers have many levers to try to prevent financial crises. Nevertheless, it is probably impossible to completely avoid crises. Therefore, we now turn to the ways they are generally resolved.

Crisis management generally involves at least three types of measures: liquidity support and guarantees of bank liabilities, recapitalization and restructuring of distressed financial institutions, and macroeconomic policy stimulus. Non-financial sector debt restructuring is also often necessary. In some cases measures specifically targeting the housing market have also been taken. The first priority when a financial crisis occurs is to stop the panic and avoid a complete freeze of financial flows, notably through extensive liquidity support. During the GFC, central banks acted decisively to restore normal operation of money markets, by increasing the amount of liquidity offered, lengthening loan terms, accepting wider collateral and lending to a broader set of institutions. Given the dependence of many foreign banks on US dollar short-term funding, currency swaps with the Federal Reserve to allow foreign central banks to provide US dollar liquidity support were also crucial. To restore confidence, blanket guarantees of bank liabilities are often granted by governments. When banks are likely to suffer from liquidity but also from solvency problems, it becomes tricky to determine where support should end. Lending to potentially insolvent institutions can entail large risks for taxpayers and generate moral hazard. For example, the blanket guarantee on bank liabilities given by the Irish government in 2008 has been widely questioned. However, the decision of the US authorities not to rescue Lehman Brothers in September 2008 led to an acute intensification of the crisis.

A financial crisis often reduces bank capital considerably, in some cases to levels below regulatory requirements. Then bank restructuring becomes necessary. In most financial crises, some failing institutions were merged with stronger ones, most of the time with some form of public support. This is a relatively straightforward way to restructure the financial system in an emergency, although it tends to reduce competition and worsen the too-big-to-fail problem. Recapitalization of viable but undercapitalized banks is essential to restore the normal functioning of the financial system and to limit deleveraging through fire sales of assets and credit contraction. In some cases, full nationalization of some institutions is the only solution, although at some point these institutions should return to private ownership. A key point is to make sure the institutions in which capital is injected are sound. Failure to do so risks creating "zombie" banks, with little positive impact on the financing of the economy, as the Japanese experience of the 1990s illustrates. A necessary step may be to remove troubled assets from banks' balance sheets, through the creation of asset management companies, or "bad banks". If assets are bought at a reasonable price, the "bad banks" may recover a large share of their investment over the long term, as shown by the experiences of the Finnish and Swedish asset management companies, and more recently NAMA in Ireland. The US Troubled Assets Relief Program (TARP) was initially aimed at buying troubled assets, but stumbled on pricing difficulties. Instead, it was mainly used for bank recapitalization. However, the viability of recapitalized institutions was assessed through stress tests (Supervisory Capital Assessment Program), whose results, published in May 2009, were well received by the markets, prompting private capital injections into banks (Mishkin, 2011). The recapitalization of European banks generally proved more challenging, in part due to slower recognition of asset impairment and the sovereign debt crisis. Hence, credit constraints have on average been tighter in Europe than in the United States in the aftermath of the GFC, all the more as the corporate sector is more dependent on bank financing in Europe than in the United States.

As financial crises have a disproportionate impact on the economy, countercyclical macroeconomic policies have an important stabilization role to play. Fiscal policy can contribute to propping up the economy. It is, however, important to stress that while economic stimulus can complement financial sector restructuring, in the absence of the latter they may show limited effectiveness, as evidenced by the protracted downturn following the early 1990s Japanese crisis, despite the implementation of large fiscal stimulus packages. Building strong fiscal positions during booms, in addition to preventing overheating, creates fiscal space for letting automatic stabilizers play and implementing discretionary easing during downturns. Nevertheless, some governments face tighter financial constraints than others. In particular, emerging economies tend to have much less latitude to implement expansionary fiscal policy in downturns than advanced economies (Laeven and Valencia, 2012). Prompt monetary policy easing is generally warranted, even though a tricky trade-off between currency stabilization and monetary support can arise in countries with heavy borrowing in foreign currencies. Very low interest rates in the aftermath of the GFC have contributed to keeping mortgage default rates low in most OECD countries, despite economic headwinds. The financial burden on households has especially been alleviated in countries with predominantly variable mortgage rates. In many cases, fixed-rate mortgages could also be refinanced, although negative equity has sometimes been an obstacle, particularly in the United States. The Federal Reserve quantitative easing program also comprised large purchases of mortgage-backed securities, contributing to improving mortgage market conditions.

Measures to address homeowner's over-indebtedness are also implemented in some countries. Lender forbearance is fairly common for residential mortgages, because financial recovery on foreclosed properties is typically low, especially when the number of foreclosures is high. Forbearance is also often encouraged by governments aiming at preventing the adverse social effects and neighborhood externalities associated with foreclosures. Hence, in most cases, foreclosures are relatively limited. The main exception is the United States, where foreclosures have been common after the GFC, despite government containment efforts, for example through the Home Affordable Modification Program (HAMP), which provided incentives for loan modification to lenders, mortgage servicers and borrowers. The very lax underwriting standards in the subprime market, combined with the multiplicity of actors involved in the lending and securitization process and the prevalence of non-recourse loans contributed to the high number of foreclosures. When mortgage defaults are limited, they can generally be dealt with modifications of repayment schedules, sometimes encouraged by government. Other government sponsored plans to rescue over-indebted homeowners, like mortgage-to-rent schemes are in place in some countries. In case where many households struggle with over-indebtedness, more comprehensive policies are needed. Large scale debt restructuring took place after the latest crisis in Hungary and Iceland, where debt had become unsustainable for many households. Personal bankruptcy legislation was reformed in Iceland and Ireland to facilitate household debt restructuring and some measures to protect the most vulnerable borrowers from eviction and restructure their debt were introduced in Spain. However, over the past few years, action to tackle household over-indebtedness has been generally limited or insufficiently effective in the countries suffering from the worst housing crises. Policies in that area are challenging, as they need to balance financial, economic and social considerations, while being fair and limiting deadweight costs and moral hazard. Nevertheless, in some cases, effective debt restructuring could allow to speed up the economic recovery and alleviate the social costs of recessions.

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Table A.1. Real housing prices cycles since 1970

Upturns	Number	Length	Housing prices	GDP	Housing investment	Private consumption	Price-to-rent	Price-to-income
AUS	6	17.0	33.6	16.5	32.0	17.9	96.7	101.8
BEL	2	71.5	119.5	50.8	68.3	48.2	123.3	124.3
CAN	2	21.5	53.4	23.4	50.6	30.1	75.0	99.5
CHE	3	42.0	53.6	25.4	47.0	23.3	125.3	130.2
DEU	3	17.0	11.8	13.4	53.1	14.7	123.5	126.0
DNK	4	22.3	69.3	18.7	68.8	17.0	114.1	127.2
ESP	4	24.8	86.2	27.4	42.7	25.2	98.5	107.6
FIN	5	22.6	43.8	28.1	42.0	25.9	105.9	115.3
FRA	4	29.3	50.0	22.7	20.8	23.1	116.8	115.3
GBR	4	25.8	95.6	24.2	30.0	32.0	113.4	122.3
IRL	2	58.0	204.7	118.9	228.3	121.0	120.0	136.1
ITA	4	25.5	57.9	15.9	11.4	17.4	107.4	114.6
JPN	4	22.8	37.5	29.8	23.3	26.0	104.6	109.7
KOR	3	17.0	25.2	27.9	76.2	24.9	115.2	108.4
NLD	3	38.7	94.8	35.7	27.9	32.7	120.8	104.1
NOR	3	11.0	23.6	14.3	7.2	14.7	95.9	118.7
NZL	5	19.0	52.9	21.2	47.5	20.7	91.3	99.9
PRT	2	18.0	19.8	19.6	26.6	19.7	114.7	114.9
SWE	2	18.5	32.7	10.0	5.9	10.7	108.0	114.8
US	4	28.3	28.5	31.8	59.2	33.6	111.5	114.9
Average	**3.5**	**27.5**	**59.7**	**28.8**	**48.4**	**28.9**	**109.1**	**115.3**

Downturns	Number	Length	Housing prices	GDP	Housing investment	Private consumption	Price-to-rent	Price-to-income
AUS	6	11.3	–7.6	7.4	–7.4	7.7	88.6	92.4
BEL	3	13.7	–15.7	6.2	–20.4	4.9	101.8	99.4
CAN	2	35.5	–18.7	24.0	–9.9	19.6	66.4	78.7
CHE	2	30.0	–33.3	5.3	–19.8	7.6	82.7	91.6
DEU	3	34.3	–14.0	17.6	–16.8	14.5	103.7	91.0
DNK	5	16.0	–21.4	2.6	–30.8	1.5	80.8	80.6
ESP	5	14.0	–22.0	2.8	–10.3	1.9	60.4	74.9
FIN	4	12.5	–22.4	–1.2	–21.4	1.0	81.8	92.7
FRA	5	12.8	–12.0	4.1	–5.7	4.4	93.0	99.6
GBR	4	17.3	–24.5	3.7	–14.5	2.3	82.2	89.0
IRL	2	28.0	–40.0	1.3	–51.4	0.2	67.5	77.9
ITA	3	16.7	–26.0	9.6	–5.7	8.9	67.5	79.7

Downturns	Number	Length	Housing prices	GDP	Housing investment	Private consumption	Price-to-rent	Price-to-income
JPN	3	31.3	–25.1	8.1	–18.3	10.9	78.4	83.2
KOR	3	23.0	–22.1	43.7	3.2	33.7	93.6	107.0
NLD	3	20.0	–25.7	3.8	–21.6	–0.7	77.3	81.2
NOR	3	19.7	–18.9	14.1	–4.2	7.4	55.2	71.2
NZL	5	12.2	–15.3	–0.6	–23.2	0.3	80.3	85.1
PRT	2	32.5	–23.5	3.0	–26.7	3.6	84.9	97.5
SWE	3	22.0	–23.4	9.7	–21.2	4.2	70.3	86.1
US	4	13.8	–11.4	2.6	–27.6	4.3	94.6	100.2
Average	**3.5**	**20.8**	**–21.1**	**8.4**	**–17.7**	**6.9**	**80.5**	**87.9**

Notes: The cycles are defined using the Bry-Boschan (1971) dating procedure, with a minimum cycle phase (upturn or downturn) length of six quarters. Housing prices, GDP, housing investment and private consumption refer to the percentage change in real terms over the cycle phase. Price-to-rent and price-to-income refer to the values at peak and trough relative to their long-run averages normalized to 100.

Source: OECD Analytical house prices database.

Chapter 2

Automated Valuation Models (AVMs): Here to stay

George Andrew Matysiak[1]

Introduction

Automated Valuation Models (AVMs) are now widely employed in both the public and private sectors (Downie and Robson, 2008). The study of real estate appraisal methods and the application of residential valuation and pricing approaches, including hedonic models, is a significant research area in both academia and commercially. There has been a substantial growth in commercial-residential AVM providers, who offer their services routinely for a fee to the public and to mortgage providers, such as banks, and other financial institutions for residential portfolio valuations. Although a variety of different underlying models are employed by individual vendors, fundamental to the approach are statistical, data mining and computing methodologies. AVMs are attracting attention from the property valuation community, leading to debate about their merits and their accuracy.

Despite traditional approaches being extensively employed in the valuation processes, over the last several years there has been a move towards automated valuation approaches as providing an initial indication of value; AVMs are now widely used by real estate professionals, government, as well as by the general public and are thus seen as complimentary to traditional valuations. The use of AVMs in assisting the processing of loan valuations is now an established practice (Downie and Robson, 2008; CML, 2007). Indeed, RICS (2013) information paper identifies the following areas where AVMs are used:

- revaluation of credit decisions in banks;
- in-arrears assessment in banks;
- identification of fraudulent activity in banks;

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- full valuation audits in banks;
- determination of capital adequacy ratios in banks;
- mark-to-market bank's portfolio of properties in banks;
- mass appraisal for local taxes by government;
- estimation of relocation compensation by government;
- cost/benefit analysis for potential public expenditure;
- capital tax planning for the individual.

These computer-assisted quantitative methods have their advantages in that they are systematic and fast, thereby reducing reliance on labor input in providing an end-to-end valuation (Tretton,2007). By removing the human element, it is claimed by some advocates, AVMs reduce inaccuracies which can arise due to reliance on human judgement and attendant biases. However, the overall attitude and degree of acceptance of such an automated approach to valuation varies enormously.

Despite AVMs having been developed and refined over the years, they are still regarded as having shortcomings (Lipscomb, 2017) and their accuracy record in assessing market prices or values is called into question. Whist there have been several academic papers estimating residential AVMs and their accuracy, the data and information used in such studies are limited compared with the larger and more comprehensive commercially oriented databases. Commercial AVM vendors emphasize that for AVMs to be accurate, considerable volumes of up-to-date market data are required.

The focus of this article is not to delve into the technicalities of AVMs or look at the various approaches used in estimating them, but to examine the available evidence regarding the accuracy of *commercially* available AVMs. The article is structured as follows. Following the Introduction, Section 1 presents a brief overview of various approaches used in modeling residential prices, Section 2 provides background information on AVMs, Section 3 and the attendant sub-sections discuss accuracy measures and report AVM accuracy figures, while Section 4 raises the question of margin for error. Section 5 provides observations and concludes.

1. Modeling residential property prices

This section provides a brief overview of some of the more common types of modeling techniques used in valuing residential properties.

There is a considerable body of literature addressing the modeling of residential property prices and values. Computer aided valuation approaches encompass a variety of methods including: Computer Assisted Mass Appraisal (CAMA)

(McCluskey et al, 1997), multiple regression analysis, artificial neural networks (ANNs) (Abidoye and Chan, 2017, Worzala et al,1995), fuzzy logic and, more recently, a rapidly evolving variety of machine learning and data mining-oriented techniques (see, for example, Zurada et al, 2011; Antipov and Pokryshevskaya, 2012).

It is important to point out that multiple regression analysis (MRA) has been extensively used and is the traditional method of choice. Typically, a multitude of property characteristics are taken into account in the modeling. Such approaches are known as *hedonic models*, which are used to measure the influencing effect of those characteristics contributing towards the overall transaction price. These models are typically estimated using MRA or some variant. However, the standard MRA approach has its limitations which are well known: the inability to adequately deal with interactions among variables, non-linearity, heterogeneity, independence of errors and multicollinearity. Kilpatrick (2011) lists some of the issues associated with multiple regression analysis.

The standard MRA approach has been extended to accommodate spatial dependency. Alternative methods have been employed in an attempt to address the spatial issue (geographic proximity) reflected in the dependence of the error terms, namely spatial autocorrelation (Bourassa et al 2010). The application of spatial econometrics and spatial statistics has made significant contributions in modeling residential property prices (Krause and Bitter, 2012; Bidanset and Lombard, 2014; Osland, L 2010).

McCluskey et al (2013) note that the relationship between property value and its explanatory attributes is highly complex and generally non-linear, which calls for more insightful approaches than the traditional MRA analysis. Other modeling approaches, for example artificial neural networks (ANNs), do not rely on any of the assumptions made by MRA and have been extensively explored (McCluskey et al 2012, 2013). The application of neural networks is one example attempting to capture complex interactions between the various characteristics considered to account for the value or price of a property.

There are many extensive reviews which summarize the variety of modeling methods employed in explaining residential property values. Refer to McCluskey et al (1997, 2013) for an overview of the various approaches and journals, such as the *Journal of Housing Research,* which contain extensive examples of hedonic regression approaches.

2. Automated valuation models

The objective of an AVM is to arrive at an estimate of a residential property's market value. AVMs have been developed and advanced for a number of reasons, in particular, they are a convenient, fast and low-cost alternative to a full valuation. They are computer-based applications, using a variety of statistical and algorithmic approaches in analyzing the relationship between the price/value of a residential property and the property's underlying characteristics. The methods used differ for different AVM vendors. Indeed, individual vendors will have available several models, making use of the most appropriate model(s) in given circumstances. However, all models, to a greater or lesser extent, will contain a degree of uncertainty surrounding the resulting property valuation. A measure of the associated uncertainty is often provided by the AVM vendor.

TEGoVA provide the following of an AVM, Definition 2.1, in their European Valuation Standards EVIP 6:

- "Automated Valuation Models (AVMs) can be defined as statistic-based computer programs, which use property information (e.g., comparable sales and property characteristics, etc.) to generate property-related values or suggested values". "

The International Association of Assessing Officers, IAAO (2003), describes an AVM as:

- "a mathematically based computer software program that produces an estimate of market value based on analysis of location, market conditions, and real estate characteristics from information collected. The distinguishing feature of an AVM is that it produces a market valuation through mathematical modelling. The credibility of an AVM is dependent on the data used and the skills of the modeler producing the AVM".

The RICS AVM Standards Working Group provides the following definition:

- "Automated Valuation Models use one or more mathematical techniques to provide an estimate of value of a specified property at a specified date, accompanied by a measure of confidence in the accuracy of the result, without human intervention post-initiation " (RICS 2013).

A key component in the RICS definition is the qualification" *(…) accompanied by a measure of confidence in the accuracy of the result (…)*". The evidence regarding AVM accuracy is discussed in Section 4.

It should be noted that all three definitions of an AVM *exclude* any direct valuer involvement in arriving at an estimate of value.

AVMs have their origins in North America, the first commercial application being in 1981, and began to be developed in the UK in the 1990 s. As noted, statistical and data mining methods are employed in estimating property values, which are calibrated on large databases of properties. Conventional AVMs originated by making use of statistical methods such as multiple regression analysis (MRA), with underlying hedonic-type models being the most extensively employed.

However, many sophisticated AVMs have moved on and employ models based on machine learning and data mining techniques. Their quality will vary considerably, depending on such features as the available data, sample sizes and the design and development of the model. This is persuasively demonstrated in the results obtained in various studies investigating residential property values and prices.

As an example of the stages involved in the establishment of a commercial AVM capability in Germany, the study by Schultz et al (2014) provides an overview. They discuss model development, the validation process and emphasize the importance of the removal of outlying observations.

No matter which quantitative or modeling approach is taken, an over-riding requirement in order to arrive at a robust AVM facility is the need to establish a large and continuously updated database of property transactions. As noted, this is something which is strongly emphasized by all AVM vendors. The database will record a variety of individual property characteristics which are deemed to determine price or value. Consequently, given the growth in the size of available databases over the last few years, this has facilitated the development of alternative approaches, employing sophisticated machine learning and data mining applications by AVM vendors in modeling, classifying and valuing properties.

An implicit assumption underlying an AVM model's prediction is that the property is in a marketable condition, with vacant possession and improved internally to normal standards. The one limitation of AVMs, in that only a physical inspection can verify these assumptions (Robson and Downie, 2007).

Whilst there are a large number of AVM vendors, the inner workings of the models and details of their specification are not released. Vendors do test their models regularly for accuracy, comparing individual property AVM valuations against achieved market prices, some claiming they have these figures independently assessed. However, the figures are not normally disclosed, especially by European vendors, and this non-disclosure puts a constraint on the analyses which can be objectively undertaken as regards an assessment of the reliability and accuracy of the models.

A report by Robson and Downie (2008) provides the results of a survey they undertook on AVMs. Needless-to-say, the AVM market will have developed considerably since the survey was conducted, but it does provide an interesting broadly-based discussion of AVMs and attitudes towards them.

Robson and Downie discuss their survey findings on AVMs and the integration of AVMs within the valuation process from an international perspective. They obtained 473 valuer responses, representing both lending and valuation organizations, described as senior professional members with 'much experience of mortgage valuations'. The results of the survey include the following findings:

- 71% of the valuers agreed that AVMs were inadequate for loan valuations as a result of no physical inspection;
- 87% of the valuers agreed that physical valuations were more accurate than AVMs, as a result of local knowledge;
- 90% of valuers agreed that the ability to evaluate comparables was a major advantage over AVMs.

It was also reported that 72% of the respondents expressed a desire 'to learn more' about AVMs. Consequently, it would be beneficial to the wider valuation community if AVM vendors became more open and transparent, explaining the workings of their models, thereby enabling the models to be fully understood and scrutinized.

An overview of the global use of AVMs is provided in the Robson and Downie report. At the time of their report (2008), the use of AVMs was 'well established' in only three or four countries. It would be interesting to obtain an update on the number of countries adopting more extensive use of AVMs over the intervening period since 2008 as, no doubt, the numbers will likely have increased. Given that number of commercial AVM providers across Europe is limited, it may be that the capacity for developing AVMs in some European countries may be constrained due to factors such as: low transaction volumes in certain market segments, a lack of comparable information, a lack of market transparency and the reliability of transactions information.

A recent discussion and general overview of the evolution of AVMs are provided in a compilation of articles by d'Amato and Kauko (2017). There are also discussions about the application of AVMs and the problems encountered in using AVMs. It is noteworthy that the co-authors observe that "some institutions consider AVM assisted valuations more reliable than valuation in person". "This assertion needs to be more fully evaluated and supported by empirical evidence.

With high levels of perceived AVM accuracy, both Fannie Mae and Freddie Mac, two of the largest funding sources of residential loans in the USA, employ AVMs as a crucial part of their valuation risk management systems. In November

2016, Fannie Mae expanded its use of AVMs by waiving the need for a physical valuation on certain refinancing loans, so-called Property Inspection Waivers.

The limitations of AVMs are well known and understood. For example: the inability to confirm or deny whether a property exists; the limited ability to address a property's condition; the limited ability to account for external influences; limited data coverage in some areas; limited ability to reflect any unique characteristics of a property, and so on. However, the crucial question is, can AVMs forecast "accurately"?

3. Measuring AVM accuracy and qualifying valuation estimates

Accurate AVMs are important for many reasons, including:

- property purchase is normally an individual's biggest lifetime purchase and an error, say+/- 5%, in the valuation is a significant component;
- mortgage providers assessing Loan to Value (LTV) ratios i.e., the value of collateral on a mortgage;
- residential values as a proportion of income/earnings ratio (credit risk);
- property values and attendant taxes;
- "wealth effect"– macroeconomic impact resulting from spending;
- borrowing (re-mortgaging);
- loan's impact on banks' balance sheet;
- regulators and Central Banks do not want a repeat of valuation inaccuracies in the boom years preceding a collapse in market values (micro/macro prudential policies so as to avoid financial stress in the economy);
- accuracy of valuation based residential property indices;
- mis-valuation implications for investment portfolio asset holdings/asset allocation.

The uncertainty surrounding the prediction resulting from an AVM valuation is usually qualified by the AVM vendor. AVM vendors typically qualify their valuation estimates by providing a *prediction range* with a specified degree of confidence. This can be achieved in a number of ways. For example, one measure is the so-called Forecast Standard Deviation (FSD), which measures the standard deviation of the percentage error between the sales price and the model estimated value.

The accuracy of AVM forecasts can be evaluated in several ways, for example:

- the percentage of AVMs falling within a specified range of error for example, within +/−5%, +/−10%, or +/−20% of the sales price;
- the median (50% of values less/greater than the median);

- average of the absolute errors (MAD/MAPE);
- the 'spread' around the 'average' of all of the errors (FSD).

In UK commercial situations involving loans from banks and financial institutions for mortgage purposes, financial rating agencies have defined a measure of accuracy which has found common currency. A *benchmark* reference is typically a valuer's assessment, and accuracy is measured against the difference between the value estimated by the AVM, compared to the valuer's assessment. In the US, the benchmark typically used in assessing accuracy is the actual sales price of the property.

3.1. AVM accuracy levels

As already noted, the European data on AVM accuracy is virtually non-existent in the public domain, the European AVM vendors being reluctant to release details. Consequently, it is not possible to provide a profile of accuracy figures, but some contextual details on the UK are provided.

3.2. UK

The two leading UK AVM providers, *Hometrack* and *Rightmove*, provided some general background information on their AVMs. Both say they undertake monthly testing of their models for accuracy and "consistency". Other than broadly based observations, they are unwilling to release the statistical results of these tests or background details of the AVM algorithms used in making the predictions.

Rightmove, one of the largest AVM providers in the UK, claims to have a database containing some eighty-six million property records. They declare they have stringent criteria, employing a thorough filtering process in selecting the properties used in their AVM models and in the forecasts. Each month Rightmove recalibrates the models to "(…) ensure accuracy and consistency in the light of market liquidity and supply and demand which will ultimately impact on price movement in different areas". The final forecast is arrived at by combining the results of two different approaches. Each month 4,000 property valuation records across the UK are used as a 'hold out' sample, which Rightmove tests against the results of their AVM forecasts.

Both vendors recognize that their AVM's will not provide accurate valuations in all situations, and caution the conditions under which their use is appropriate. Emphasizing the effective role and use of AVMs, *Hometrack's* view is: "understanding the inputs and processes is key but it's the accuracy, quality and consistency of the outputs against a clear benchmark valuation that is most relevant to end users. Knowing when not to use an AVM is as important as having the confidence to use one".

Rightmove and Hometrack take the view that looking at the accuracy figures in isolation can result in a misleading picture, Hometrack further observes, "(…) there is a whole/use/application story that needs to sit alongside accuracy (…)". Consequently, neither is prepared to release broad profiles of accuracy figures.

An indirect insight into the standing of UK's AVM accuracy figures can be obtained by looking at how credit rating agencies review the accuracy of AVM vendors valuations as part of their rating process of residential mortgage-backed securities (RMBS), where residential properties have been valued by an AVM. Although the credit rating agencies do not release details of the accuracy figures resulting from their investigations, the upshot of their analyses is reflected in the adjustments which they make to AVM determined values.

When looking at securitization risk for residential mortgage-backed securities in the UK, Fitch Ratings (2012) examined the underlying property values when assessing the intrinsic risks in the mortgage loan. They subsequently make adjustments to the reported AVM valuations which reflect a number of factors, listed below:

- historical relative reliability of AVM values against surveyor values;
- quantity and quality of data sources;
- quality of the model calibration framework;
- frequency and quality of maintenance procedures for each AVM vendor;
- lender's procedures around application of AVM values.

This is a rigorous list of checks for AVM originated valuations. As a consequence, Fitch Ratings apply a 'general adjustment' to all AVM valued properties where securitization and covered bonds are involved. Over the years, there have been several updates to their treatment of automated valuations in securitization and covered bonds. In the UK, for example, Fitch Ratings Criteria Addendum: UK (2016, Appendix 2) states:

"General Adjustment: A 2.5% haircut will be applied to take into account the time lag between registration of a property and its eventual incorporation into the AVM database. This time lag is typically 1.5 months, up to a maximum of three months".

In addition, there are other adjustments at pre-defined levels for low valued properties and for relative reliability levels, which vary, depending on the AVM provider. For example, in the case of two of the largest UK AVM vendors, Hometrack and Rightmove, a 3.5% valuation haircut is imposed for low valued properties in the case of Hometrack and 0% for Rightmove. These values are subject to regular review, and the adjustments may change from time-to-time in the course of a criteria review.

It is interesting that these "haircuts" are not applied to standard physical valuations, although "other adjustments *may* apply". Clearly, Fitch Ratings makes a distinction between AVM valued properties and physically valued properties in their assessment of the underlying valuation risk. However, currently it is not possible to draw any insightful conclusions about the numerical AVM accuracy for the UK or European AVM vendors.

3.3. USA

We next consider AVM accuracy in the USA. One of the largest vendors in the US analyzing the accuracy of their AVMs is *Zillow*. Another leading provider of AVMs is *HouseCanary*. The results reported below reflect the accuracy figures of these two vendors.

HouseCanary and Zillow continually provide updated accuracy figures on their websites in some detail, which should be referred to for an up-to-date profile. In addition, HouseCanary provided the author with information on the distribution of their accuracy figures for different valued property bands. Both vendors appear to be transparent and open in disclosing the distribution of their accuracy estimates. HouseCanary says that their figures are independently verified, whilst Zillow do not confirm whether or not their accuracy figures have been independently examined.

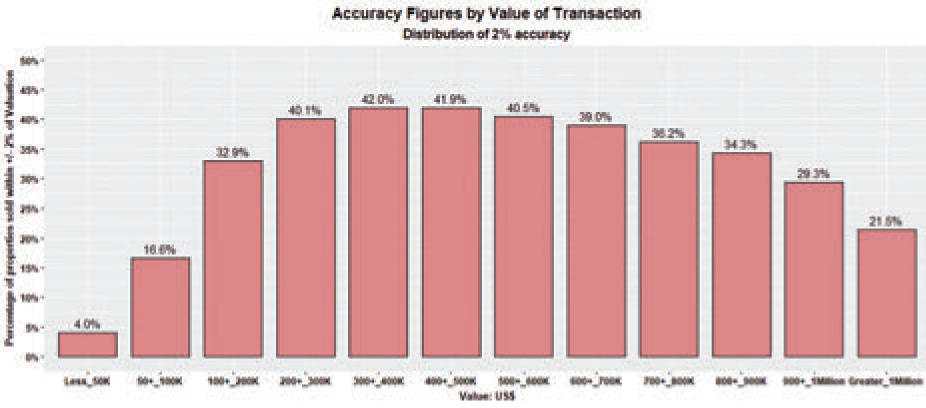
In order to put AVM accuracy profiles into perspective, the *distribution* of the various accuracy measures was obtained. The figures cover two data features, accuracy by *size* of property and accuracy by the US metropolitan *location*.

3.3.1. HouseCanary

HouseCanary kindly provided figures for the percentage of properties by size i.e., value band, whose values fell within +/- 2% of the eventual sales price. This is a very demanding margin for error. Figure 1 shows the distribution of the figures.

It is seen that the highest levels of accuracy are around 40% for properties within the 200–600 thousand USD price range. For low valued properties, less than 100 thousand USD, around 17% of properties were valued within the +/- 2% range. Interestingly, accuracy reaches a maximum of 42% for properties within the 400–500 thousand USD bracket and steadily declines to a figure of 21.5% for properties with values in excess of 1 million USD.

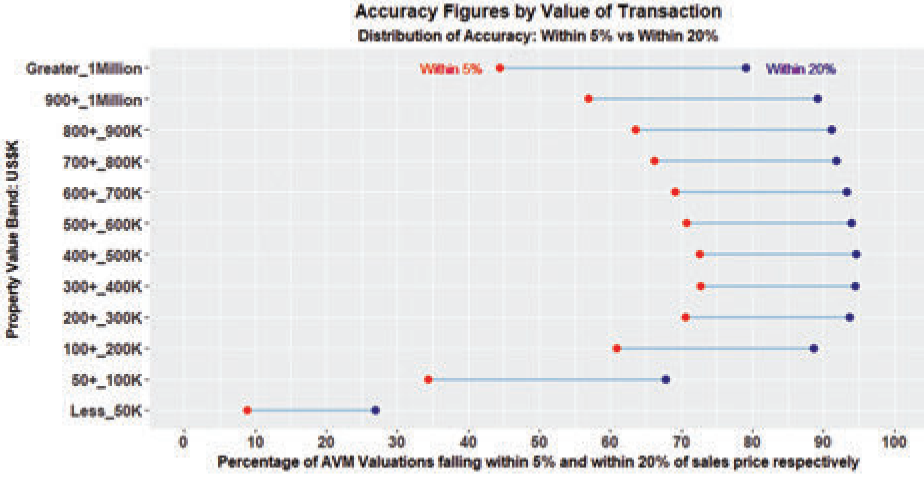
Figure 1. Percentage of valuations falling within +/–2% by size of transaction



Source: HouseCanary.

Figure 2 summarizes the distribution of accuracy figures by size of property for different levels of accuracy. The figures show the percentage of properties valued within +/–5% of the sales price and within +/–20% of the sales price, across twelve price bands.

Figure 2. Distribution of accuracy by size of transaction



Source: HouseCanary.

The figures may be summarized as follows:

- What stands out for the lower valued properties i.e., less than 50 thousand USD, less than 10% of the valuations were within +/- 5% range of the achieved sales price, rising to 27% within +/- 20% range of the sales price.
- For property values in the range of 100 thousand –1 million USD, the figure shows that over 85% of values are within +/- 20% range of the sales price, with 80% of properties valued over 1 million USD falling within the +/- 20% band.
- If 10% is seen as an acceptable margin for error, for properties with values exceeding 100 thousand USD, around 75% of the valuations fall within +/- 10% range of the sales price, and hence, one-quarter of AVM generated appraisals will have errors greater than +/- 10%.

The *median absolute percentage error* across all properties (674 metropolitan statistical areas, MSAs, as at June 2017) amounts to 5.6% i.e., half of the errors nationwide were within 5.6% range of the final selling price, and half exceed 5.6%.

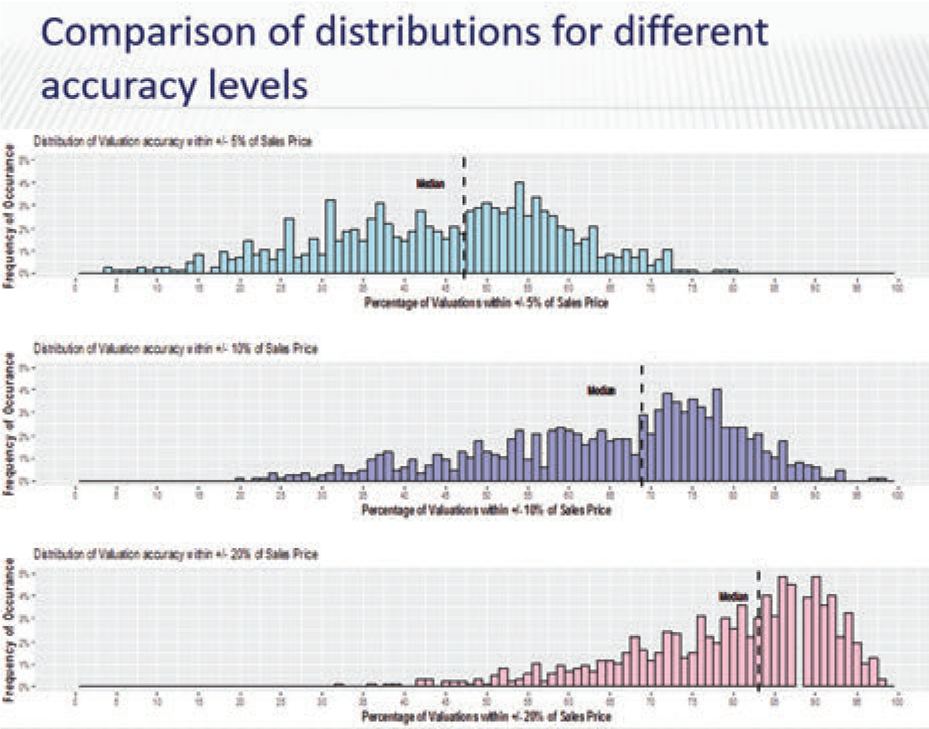
3.3.2. Zillow

Zillow claims to be the largest AVM provider in the US. The following histogram compares distribution of Zillow's AVM accuracy rates across 864 US counties. Different locations i.e., counties, will have different valuation errors and the histograms show the distribution of AVM valuation accuracy *within each of the individual 864 counties* for different levels of accuracy.

The figures may be summarized as follows:

- The median level of *valuation error across the US* is 4.3% (as at June 2017) i.e., half of the errors nationwide were within 4.3% range of the final selling price, and half had an error exceeding 4.3%.
- Top histogram: shows +/- 5% valuation accuracy rates; middle histogram: +/- 10% valuation accuracy rates and bottom histogram: +/- 20% valuation accuracy rates. Histograms provide a detailed visual insight across 864 US counties.
- The average accuracy across all counties is superimposed in order to provide a reference point. On balance, it appears that around 50% of the valuations are *likely to be outside* the +/- 5% range of achieved sales price, which falls to almost 30% for the +/- 10% range and 17% for the +/- 20% range.
- *As shown in the histograms, given the skewed nature of the distributions, even at the wider range of +/- 20%, there exist a significant proportion of valuations in many locations which lie outside the specified range of accuracy.*

Figure 3. Distribution of accuracy levels across counties



Source: Zillow and author's summary.

Table 1 provides summary statistics calculated from Zillow's raw figures, describing the features at the individual county level, based on 864 counties across the US.

Table 1. Percentage of Zillow valuations in counties falling within the specified limits

Statistic	Within +/–5%	Within +/–10%	Within +/–20%
Average (across all locations)	45.0%	65.2%	80.0%
Min. (lowest % for a location)	3.6%	20.0%	32.1%
Max. (highest % for a location)	79.6%	98.1%	100%

Source: Estimated by the author based on raw data obtained from Zillow's website.

Note: Min. is the lowest percentage of valuations for an actual county falling within the specified +/– limits. Max. is the highest percentage of valuations for an actual county falling within the specified limits.

The key features shown in Table 1 are:

- 45% of all valuations across all counties were within +/- 5% range of the sales price, 55% exceeding +/–5% range. However, this can vary between 3.6% and 79.6%, depending on the county.
- The average percentage of valuations across all counties falling within +/–10% range of the sales price equals 65%. However, this can vary between 20% and 98%, depending on the county.
- On average, the percentage of valuations across all counties falling within +/–20% range of the sales price is 80%. However, this can vary between 32% and 100%, depending on the county.

Other notable features of the Zillow data include:

- At the *individual county level,* the median value ranged from around 2% to 32%, which represents a wide range of variation in accuracy across the different locations.
- One quarter of the counties (216) had 65% of their valuations falling outside +/–5% range of the sales price.
- One quarter of the counties (216) had 45% of their valuations falling outside +/–10% range of the sales price.
- One quarter of the counties (216) had 27% of their valuations falling outside +/–20% range of the sales price.

3.4. Comment on the US AVM accuracy figures

With high levels of perceived AVM accuracy, both Fannie Mae and Freddie Mac, two of the largest funding sources of residential loans in the US, employ AVMs as a crucial part of their valuation risk management systems. In November 2016, Fannie Mae expanded its use of AVMs by waiving the need for a physical valuation on certain refinancing loans, so-called Property Inspection Waivers.

Given the longer experience in developing and using AVM models, it may be assumed that the US models are more established and leading-edge compared to their European/UK counterparts. Furthermore, it could be argued the accuracy of US's AVM models would define an upper limit for European/UK AVM accuracy levels. Consequently, the US average of around 65% of valuations falling within a bracket of 10% would seem to be an upper limit for European/UK AVM valuations. However, given a 10% bracket, anything between 20% (the Zillow min.) and 98% (the Zillow max.) is also possible. If a 5% bracket was regarded as a tolerable margin for error, the levels of accuracy would fall considerably (Table 1).

The US's AVM accuracy figures need to be put into perspective. The reported figures are averages, which also vary depending on the county, as shown in the profiles in histograms A1, A2 and A3. This clearly demonstrates that there is a wide distribution of inaccurate AVM valuation figures across the US counties. AVM models should not be perceived as providing seemingly consistent and reliable valuations across the board; sometimes they do and sometimes they don't. Furthermore, these figures are likely to vary under different market conditions, for which there is no information.

3.5. Validating AVMs

The earliest endeavors in looking to establish AVM standards can be traced back to 2003 (a brief profile is provided in d'Amato and Kauko (2017, pp 3–21)). Reference to three particularly relevant sources should be made.

The Collateral Risk Management Consortium (2003) issued their CRC Guide to Automated Valuation Model (AVM) Performance Testing (2003). The guide represents an extensive review of AVM performance testing practices. The CRC noted that lending institutions struggle with unique AVM databases, propriety technology and systems and very different quality control measures, recognizing that there was no consistent way to evaluate or rank AVMs in relation to any industry standards. The guide recommended a number of tests for evaluating residential AVMs. Many of suggested metrics were found help in current discussions on AVMs.

- Hit rate;
- Comparison of AVM valuation to sales price;
- AVM percentage error;
- AVM bias;
- Number of outlier outcomes;
- Comparison of AVM percentage error to vendor confidence level.

There have been several publications which have outlined standards for AVM. In 2003, the International Association of Assessing Officers (IAAO) in the US published a detailed report providing standards for the use of AVMs. The IAAO standard went into considerable detail regarding many aspects of AVM development covering such matters as data capture, model specification, calibration and the delivery of outputs.

Indeed, as far back as 2004 Fitch Ratings had issued an alert to vendors of US residential mortgage-backed securities (RMBS) that there was a significant delay/lag in translating market trends into the data used by AVMs (this decision was subsequently reversed in 2006).

The European AVM Alliance (EAA) has recently issued a document (European AVM Alliance, 2017) setting out guidelines and standards for the statistical valuation methods. The standards outline the types of statistical valuation, reviewing their suitability for different uses. Furthermore, they discuss how the different parties such as lenders, investors and regulators should evaluate the resulting performance of each approach. They discuss the minimum requirements for statistical methods, including guidance about selecting a suitable method.

The declared objective in setting out the standards by the EAA is formulated as follows:

"These Standards for Statistical Valuation Methods for Residential Property in Europe are intended to provide for the first time a coherent set of information and descriptions aimed at increasing the understanding, transparency and clarity on the wide array of existing Statistical Valuation Methods. The document focusses on principles, definitions and minimum requirements for Statistical Valuation Methods applicable across European jurisdictions".

As it stands, the EAA document is framed in general terms and not too prescriptive, identifying broad areas which need to be addressed, whilst inviting comments. It remains to be seen how the standards are implemented in practice.

4. Margin for error

What is an acceptable margin for error? This is a much-discussed concept which is developed in the UK's case law, for example. An observation which can be made is that market conditions and specific/unique property characteristics would likely raise or lower the margin. Indeed, although different than the residential market, in the commercial property markets there can be a significant variability in valuation accuracy in different periods, including biased valuations when markets are moving relatively rapidly or when markets are 'thin'; for the UK evidence see Matysiak and Wang (1995). Based on case law over several years in the UK, an acceptable margin in commercial property appears to be in the region of +/−10%. However, recent UK experience puts the margin of error in the +/−15% bracket, depending on how "specialized" the property was; the more specialized the more uncertainty about the market value.

Figures reported by *MSCI* put country *averages* as varying between 9.1% and 12.5% over the seventeen-year period 2000–2016, depending on the country. Individual yearly figures can vary considerably around these averages.

The residential markets are more liquid with greater volumes of transactions than in commercial real estate markets, and consequently, perhaps could be expected to have lower margins for error under "normal market" conditions. If the Zillow and HouseCanary figures are regarded as representative, then, the overall median values are 4.3% and 5.6% respectively, which are less than the reported commercial real estate averages.

An important question is, what is a "normal" market and what would be an acceptable margin for error for residential properties in such a market and how would this vary over different market conditions? More generally, there are whole series of situations which would need to be taken into consideration when assessing acceptable margin for error in evaluating a residential property, including:

- different market environments, including rising/falling/volatile markets;
- different size/value properties;
- quality of property;
- age of property;
- market liquidity e.g., dependent on the volume of transactions;
- geographical location/different neighborhoods;
- the type of property.

Many of these are likely to be country specific and so, the margin for error will likely vary in different countries. More country-wide empirical evidence needs to be obtained and reported.

5. Discussion and conclusion

Over the last twenty years, property valuation has evolved from traditional manual sales comparison methods and subjective valuer assessments, based on comparable evidence, into mechanically oriented (automated) valuation models.

Advances in the availability of computer technology and data management systems have enabled the widespread development of AVMs. AVM vendors emphasize that the model estimates provide an indicative valuation of the likely property's sales price in the open market. Furthermore, given the uncertainty surrounding the estimate, a measure of the underlying uncertainty is also provided, which can be variously expressed.

There is a little available published evidence on the accuracy of European AVMs. Indeed, there appears to be a reluctance to provide information or open-up methodologies more widely to independent scrutiny. In the circumstances, the accuracy of current AVM European-based services remains largely unverifiable.

In comparison with European vendors, American AVM service providers are unquestionably more open making their accuracy results publicly available. The distribution of the accuracy figures of the US models, both *across* and *within* locations, appears to provide results which could be considered as acceptable levels of accuracy for AVM valuations. However, a purely derived statistical or data-mined valuation risks being widely off the mark, as reported in Section 4. Consequently, despite the high degree of accuracy reported by the AVM vendors in the US, there remains a requirement for professional judgement to augment model-based valuations, thereby arriving at a more broadly considered valuation estimate. Put prosaically, this may also be regarded as a check on the soundness of the model-based valuation.

AVM observers will continually raise the question, how impartial are AVM's reported accuracy figures? Consequently, any reported AVM vendor figures, together with attendant conclusions, need to be critically evaluated. Property values are determined by a mix of qualities and conditions, a model only capturing the broad characteristics, leaving the detail out. Given that there will be differences in information/knowledge about a local market, which may not be widely disseminated, this makes for an imperfect market. Consequently, a thorough assessment of value requires not only experience where judgement is called on, but also knowledge of local market conditions where individual properties may be dissimilar in a variety of ways.

To put AVMs into perspective, Tretton (2007) takes the view that AVMs contribute in the process of arriving at a valuation, but ultimately the quality and accuracy are data and valuer led; there is no automated replacement for subjective professional judgement.

In order to provide a transparent basis for assessing the robustness and accuracy of AVMs, full details of the underlying methodologies employed in arriving at values would need to be reported. Reliance on analyzes and results reported by AVM vendors themselves will always raise questions of how impartial the reported results really are. Consequently, any reported vendor conclusions need to be critically evaluated. In which case, consistent and transparent standards are required.

Regardless of how complex or elaborate an AVM may be, how much data was employed in estimating it or how many comparables were selected in arriving at the prediction, the bottom line test is, how "accurately" did it predict property prices? The predicted estimate is often qualified by the forecast uncertainty, whether it be expressed by a range or some other measure of confidence, such as the FSD. If it does not predict accurately, the model is deficient. Consequently, prediction accuracy offers one objective measure in validating the robustness of an AVM.

An important question in the debate about the use of AVMs is: are AVMs more accurate than physical (valuer) valuations? In this regard, more evidence needs to be obtained and reported in order to support any stance.

The independent validation and standards of validation of European AVMs need to be promoted more vigorously, otherwise the role of AVMs will continue to be misunderstood and contested. Until AVM vendors provide details of their models to open scrutiny, their claims of robust and accurate models cannot be regarded as impartial. Furthermore, more discussion is needed about what is a fitting framework for assessing and evaluating AVMs.

AVMs continue to have an impact on valuation practice. They are extensively used around the world and have become part of the valuation environment. Given the widespread deployment of AVMs, their use is not an either-or question, but a question of *how* can an AVM enhance a valuer's estimate of value. It is not about a *contest* between AVMs and valuers, but the *complimentary* use of AVMs in a valuation situation – it is up to the valuer to decide what an AVM contributes in any situation; this is an individual valuer's decision.

The position has been well summarized by a significant provider of valuation technologies to the mortgage banking industry as follows: "AVMs are going to get more and more mainstream, particularly as data and analytics become more sophisticated. AVMs won't take the place of an appraisal. There will always be a need for local knowledge and expertise, not to mention an on-site evaluation of the physical property."

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Chapter 3

A simple model of the housing market and the detection of cycles

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Introduction

The real estate sector consists of land and buildings, which can be traded and generate services to the owners or tenants. This sector is very capital intensive, the value of the real estate stock (both residential and commercial) exceeds the size of the GDP, in some countries even several times. Changes in its value have a very important impact for the economy, they affect the behavior of households and also determine the value of collateral for banks.

This sector is ruled by laws and by the market. The most important markets are the market for objects (creation of the capital stock and changes of its owners) and the market for space that can be rented (services, which the real estate generates) (see Wheaton and DiPasquale, 1992 and Fisher, 1992). The demand in the market is closely related to the financial sector which allows market participants to purchase real estate, while the construction sector, together with the market for land and construction material generates new objects.

Each property is a capital good that also generates a stream of utility, and each property is different, because of its location, age and quality. The rent someone is willing to pay should be – in the long run – related to the value or construction cost of the given real estate, but this can vary in the short term. Recently, due to low interest rates prices went up, while rents remain stable.

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This article presents the opinions of its authors and not necessarily the official position of the Narodowy Bank Polski.

1. Housing market fundamentals

To understand cycles, we need to understand the fundamentals of the housing market first. Housing is a consumer and an investment good, and this fact is very important for the behavior of households. If housing is considered a pure consumption good, households should optimize their consumption, which means that we should not observe strong demand booms. When demand for housing goes up, its price goes up and in a standard consumer model the demand for housing should decline again. Demand shocks would be very short-lived. Many consumers would like to sell their house to investors and rent it. On the other hand, if housing would be a pure investment good, people would buy at low prices and sell at high prices. We do not observe such a behavior, contrary, we observe that people buy even when prices are high. And this results from the complex function of housing. People are afraid of future increases in rent levels, thus prefer to buy housing. They decide to buy housing when either income is growing or interest rates decline, and then a lot of other people want to buy, too. We observe a strong herding behavior and as people are worried about future price growth, they anticipate the purchase decision and add to the demand boom. In another chapter in this book (see Augustyniak et al., 2018) we present a simple four equation model of the primary housing market in Warsaw. We notice a negative relationship between price levels and demand, but we also find a strong effect of the appreciation of housing on the demand for housing.

Housing market follows business cycle, because housing demand reacts with a lag to the economic growth. This also means, that one recognizes a prolonged demand, even when the whole economy is slowing down. And when people finally realize the economic downturn, the housing demand ends abruptly and prices fall. Analysis by Łaszek, Leszczyński and Olszewski (2017) indicates such a behavior and points out that the commercial real estate market is closely linked to the business cycle. Firms analyze the market and when they expect a growth in employment, they ask for more office space or more retail space. As a result of growing employment and growing income, households demand more housing and this market starts to grow. Leszczyński and Olszewski (2017) performed a panel analysis of house price determinants in the primary and secondary housing market in sixteen Polish provincial cities and found that the primary market reacts stronger to changes in income than the secondary market, while the secondary market reacts stronger to changes in interest rates than the primary market does. They conclude that most likely housing on the secondary market is bought by first time buyers, who have a tight budget and need a mortgage, while housing on the primary market is more likely bought by those who have a higher income and probably sell their old flat and buy a new one. In such a situation, their wish to buy new housing results from their improving economic situation and they need relatively little mortgage to close the gap between the value of the old and the new flat. Also, the analysis presented in NBP (2017, p. 44) shows that around 60% of the value of purchased flats on the primary market in the largest cities is financed with cash. Most likely this cash comes from the selling of the old flat, but also from savings. Because investments in rental housing are a profitable business in the low interest rate environment, one can expect that there will be a share of investors who move their wealth from various assets to the housing market. On the one hand cash purchasers do not generate any risk to the financial system as they use their own cash, but on the other hand such cash purchasers can generate a price boom in the biggest cities, where investments appear to be most profitable. So far there is no instrument to make such investments unattractive. If prices increase, people who need mortgages will need to take a larger mortgage and the bank might be willing to give it to them. Granting mortgages is profitable and as long as house prices are stable or even rising, the mortgage is well secured. In any case, when interest rates are low both consumers and investors want to buy more housing.

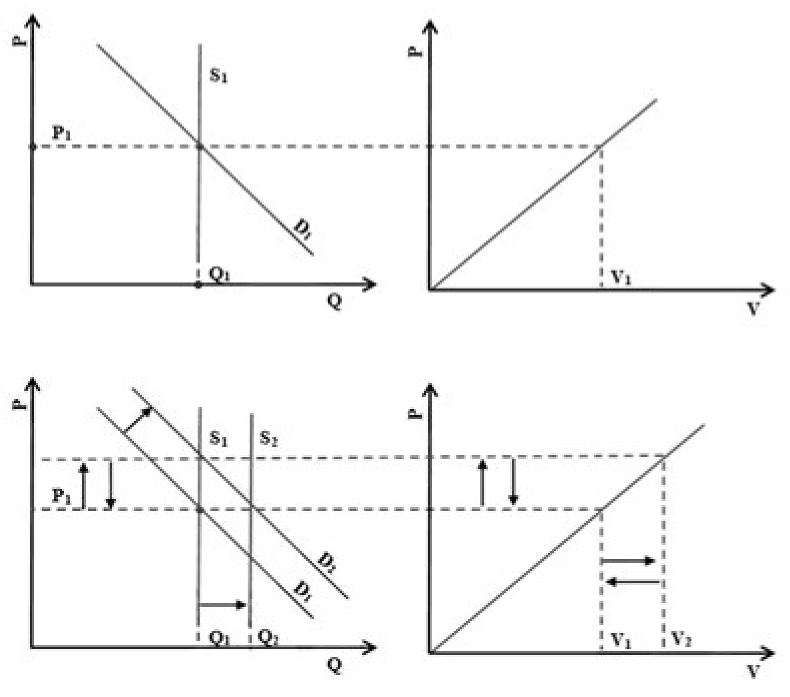
1.1. The fundamental housing model

The most fundamental model of the real estate sector is the Fisher-DiPasquale-Wheaton model (Wheaton and DiPasquale, 1992 and Fisher, 1992). We present in Figure 1 two selected quarters of the model that deal with the demand and supply for space (denoted Q) at a given rent level (P) and the relationship between the value and the rent level under a given interest rate. The value of a square meter of property (denoted V) is the discounted stream of rent it generates (denoted P), where the discount factor takes the interest rate and the risk premium into account (r). In such a model a direct relationship exists between rents and the property price and the non-arbitrage condition applies, thus a given rent to price ratio will be achieved in the long run. The mechanism is as follows. When rents are very high, owners are willing to rent their property to others and even want to buy more housing, by which prices increase and the price-to-rent ratio returns to its long run level. In the opposite case, when rents are very low, owners are ready to sell their property and rent it from others, thus house prices decline while rents start to grow.

The supply on the market is the whole available space, which is constant in the short term (depicted with line S1 in the upper panel of Figure 1). When the interest rate or the risk premium decline, a property that has a constant rent obtains automatically a higher value. Increases in demand for space make rents go up, which directly translates into rising prices of the objects (this is shown in the lower panel of Figure 1). When prices go up, construction of new objects becomes more profitable, thus developers start to deliver more objects to the market. Over the cycle there will be enough objects on the market to meet demand and their price will decline to the initial price. In the long run, property prices will be equal to the construction costs (land, material and labor). Construction costs are the result of demand and supply of land, material and labor and they change over the cycle. When prices exceed construction costs, new construction becomes more profitable and more objects are constructed. But when prices are lower than construction costs, new construction becomes unprofitable and stops.

The simple model shows that short term cycles are generated by changes in the demand for objects. The total supply of objects changes very slowly and follows the total demand in the long run.

Figure 1. The Fisher-DiPasquale-Wheaton model (upper panel – equilibrium, lower panel – shift in demand)



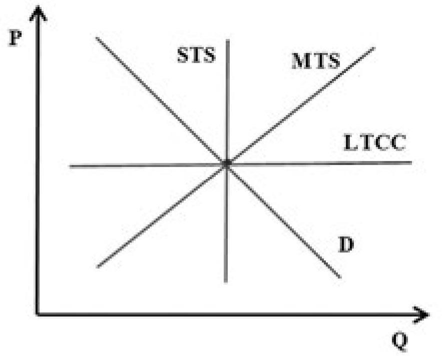
Source: own modification of DiPasquale-Wheaton model.

When owner occupied housing (OOH) is analyzed, the market for objects and space can be analyzed jointly, as the object market is the most important one in this context. Housing is a heterogenous good and its price results from the value of the utility which its attributes generate. However, one has to buy a basket of attributes and can only choose between baskets offered on the market. For example, in a good location there might be only small and old flats, while larger ones are in a remote location. The situation is slightly simpler in the commercial space market, where the offered property is more homogenous from the demand point of view. Owners put a lot of money into their property, thus plan for the future and have high expectations. Renters are concerned about the rent and can change the location and quality nearly every year. In the OOH market the consumption motive plays a dominant role, therefore the financial market, through the interest rates, determines mortgage availability and thus housing demand. Imputed rents, discounted with the interest rate play a minor role for owners. However, under specific conditions i.e., low interest rates, the investment motive can start to dominate and under high price growth the speculative motive becomes a significant demand driver.

The housing market consists of the whole housing stock and all people who satisfy their housing needs. Transactions in the market are those of new housing which is used to replace outdated housing and satisfy increases in housing demand, and also transactions in the existing stock. Transactions of housing units are rather rare, they account for only few percentage points of the stock per year (contrary, on the rental market for housing contracts can be renegotiated nearly annually and a significant part of the rentable stock is on the market each year). It should be noted that a small amount of transactions determines the value of the housing stock and can have a huge effect on the economy, for example through the collateral channel.

In a simple housing market model, the supply is the sum of new constructed flats and those who become empty from the whole stock (see Figure 2). Demand is determined by the usual factors: demographics, income growth, interest rates and subsidies. Moreover, it results from the relocation of people from one city part to another, change in the usage of housing as commercial space and also the depreciation of the existing housing stock. Supply is fixed in the short run (STS), because developers deliver to the market housing they have planned and started to construct some years ago. In some countries, pre-sale contracts can be sold, but this does not really satisfy housing demand until the flats are completed, is risky for the buyer and can be a signal for tensions in the market. In the medium run housing production increases (MTS), but construction prices go up quite quickly. Only in the long run the production of construction material and the labor force adjust to the new production levels and costs move back to their equilibrium levels (LTCC).

Figure 2. Short, medium and long-run supply of housing and housing demand

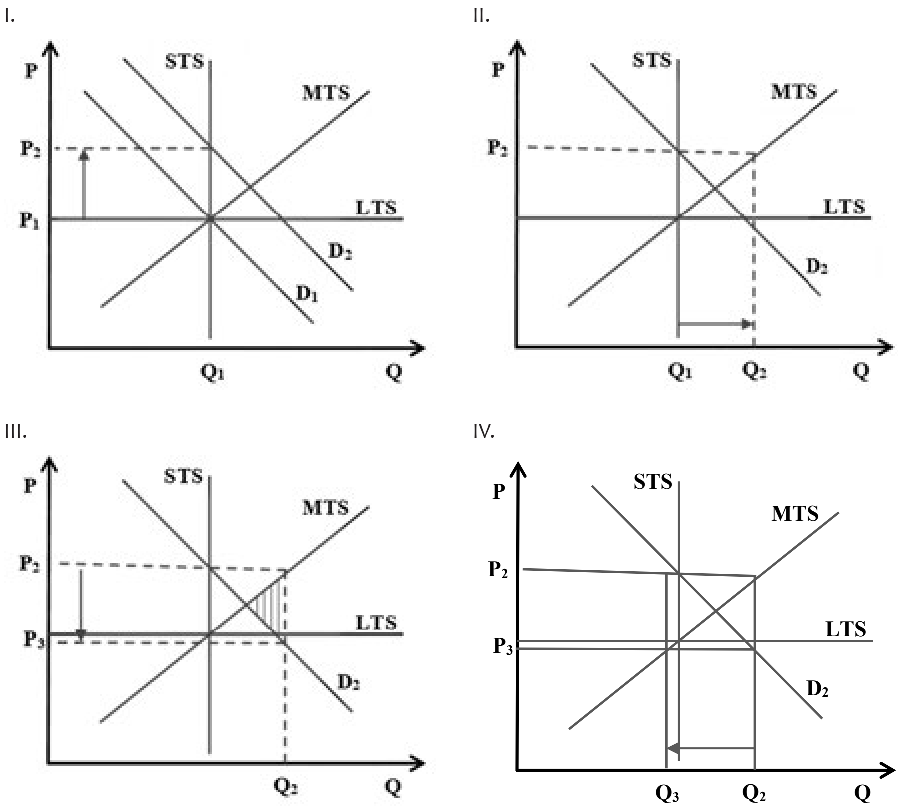


Source: own modification of the *DiPasquale-Wheaton model.*

2. Cycles on the market

Cycles are a natural phenomenon of the housing market, because of the lag between the construction start and the delivery to the market. The usual cycle is triggered by the simultaneous occurrence of economic triggers, such as decrease of interest rates, demographic factors, subsidies, which lead to a demand boom (Figure 3, part I). It is unimportant, whether those triggers are fundamental or just short-lived, because in both cases developers increase new construction. Developers tend to overestimate the factual demand, but also can restrict supply in order to let prices grow even more. The initial price increase generates further price increases, as some people start to speculate, others buy faster because they are afraid of further price rises, which adds to the price bubble and consequently production boom (part II). However, at some point banks and large investors realize that the market is overheated and curb lending or stop purchases, which leads to a significant drop of demand and price starts to decline (part III). People who wanted to make a house purchase hope that prices will fall further and postpone their decisions, thus demand decreases even more. When prices drop below a certain point, the whole housing stock can be affected as people with a mortgage that exceeds the collateral might want to stop to pay the mortgage and to go bankrupt. A large wave of forced sales will decrease prices even further and be harmful for banks that financed flats. The end of one cycle can trigger another one, when new construction was reduced to a minimum (part IV). Demand will again exceed supply.

Figure 3. The demand and supply cycle in the market

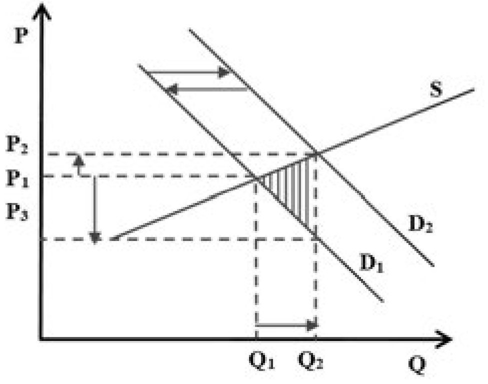


Source: own modification of the *DiPasquale-Wheaton model.*

Another scenario is a slow recovery of the economy, with a low demand for new housing and a large stock of unsold housing (see Figure 4). If developers are left with a significant stock of unsold housing from the previous cycle, their financial strength and the behavior of banks that finance the construction projects will determine whether the developers survive or have to go bankrupt.

The housing market cycle can be described with the same methods as the real business cycle. It starts with the expansion phase and a price boom. The abrupt decrease in demand and the following price drops initiate the crisis phase, which lasts until prices stabilize and the bottom of the cycle is reached. A this point the depression phase begins, and it lasts as long as there is unsold housing on the market. A lasting lack of new housing and income increases initiate the recovery phase, which can again lead to a boom when supply does not catch up with the increasing demand (see Figure 4).

Figure 4. The cycle in the real estate market



Source: own modification of DiPasquale-Wheaton model.

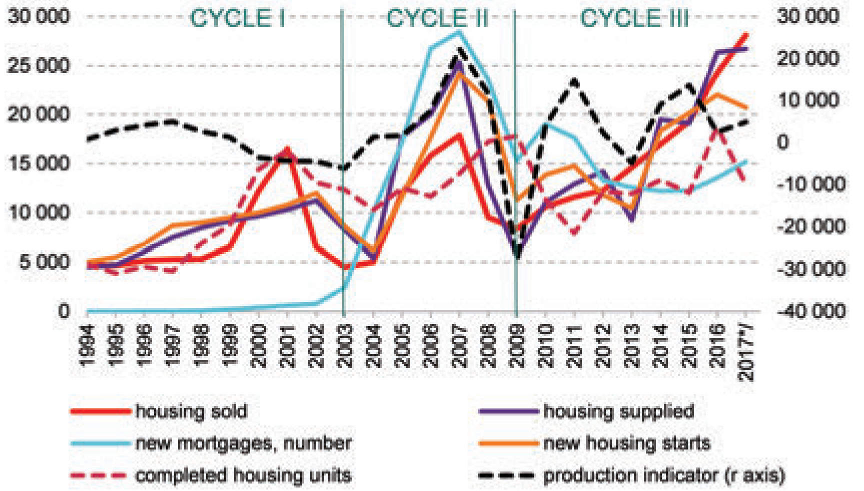
2.1. Detection of cycles and their phases

Price growth, which exceeds inflation, is an early-warning indicator of market tensions as evidenced by an analysis of the simple model and empirical observations. When the supply side is elastic, a worrying signal is a fast increase of new construction and purchases at stable prices. As stated above, it is unimportant whether the triggers of the cycles are fundamental or just incidental, because the effects are basically the same, and the cycle starts its own life. Usually increases in consumption and speculative demand are fueled by mortgage growth, thus price increases and fast mortgage growth are an indicator of tensions. A demand boom can be triggered without a mortgage boom, when interest rates are low and households withdraw their savings and purchase housing for investment purposes. Large sales on the primary housing market also indicate that there is a boom, as at some point housing demand can be only satisfied with new construction. Purchasers will at some point accept risky pre-sale contracts for housing that will be delivered in the near future. When construction exceeds the usual levels significantly, construction land becomes a scarce good. Its price increases quickly, even faster than house prices, as land has a small fraction in the total cost but is a vital input in the construction process. Physical or administrative land availability is another barrier for the increase of housing construction, which can be a significant problem. There might be also problems to acquire enough qualified workers. Finally, when demand is excessive, new entrants buy pre-sale contracts for whole buildings from incumbent developers, hoping to finish those projects quickly and making excessive profits.

3. Cycles in the Polish housing market

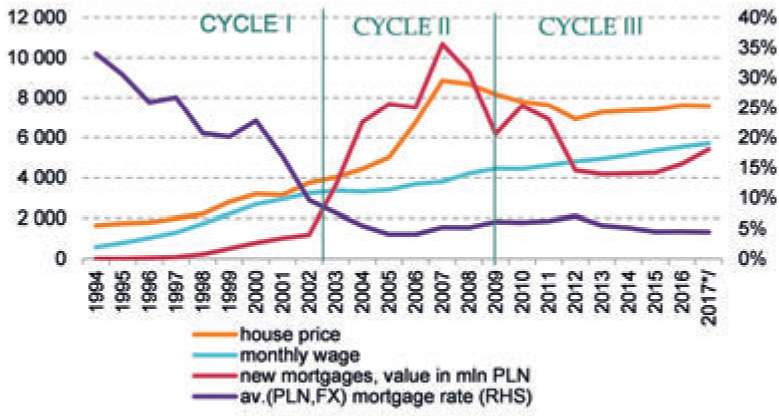
The housing market in Poland underwent three cycles in the 1994–2017 period. None of the cycles, even considerable construction booms, resulted in a crisis, because the sector has only a small share in the GDP and also housing finance is relatively low in relation to the GDP. Each cycle was driven by different factors, had a different shape and resulted in different price reactions. The first cycle was only observed in Warsaw and it was the result of the abrupt end of subsidies. Prices increased only as fast as income growth and the construction boom was possible as for the first-time private firms could operate on the market. The second cycle was observed in five biggest cities and was driven by a mortgage boom that was the result of very low foreign denominated mortgage rates. The price increase was abrupt and signs of a bubble creation could be observed on some markets. The third – current – cycle was caused by monetary policy, and we observe a demand and supply increase, while prices remain rather stable. The cycles are presented in the next figures.

Figure 5. Cycles in the housing market in Warsaw in 1994–2017



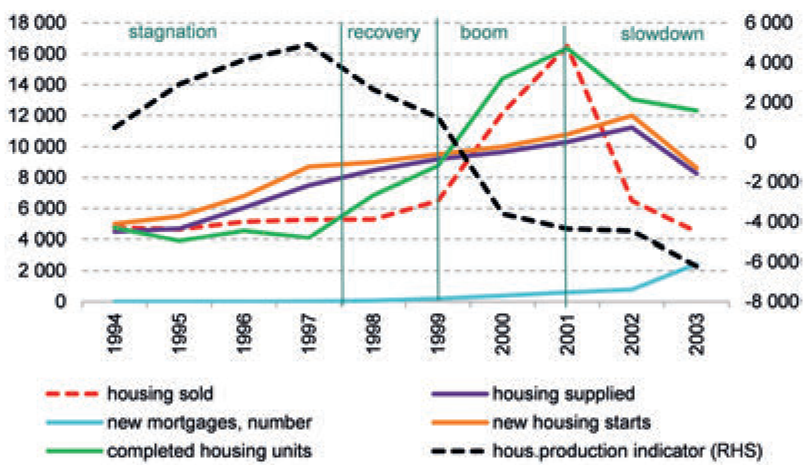
Source: own calculations based on NBP, CSO, REAS, BIK data.

Figure 6. Determinants of the housing cycles in Warsaw during 1994–2017



Source: own calculations based on NBP, CSO, BIK data.

Figure 7. Cycle in the housing market in Warsaw in 1994–2003



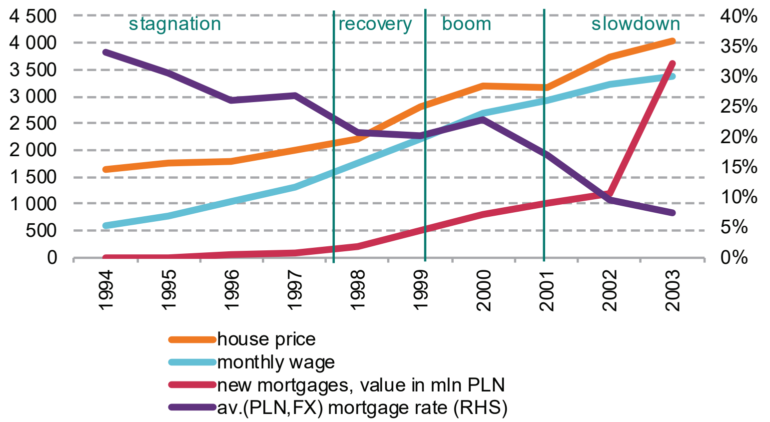
Source: own calculations based on NBP, CSO, REAS, BIK data.

The first cycle was a classic example of oversupply, which appeared when the government announced to stop a very broad subsidy program and to raise the VAT on building materials at the end of 2001. Many people who were able to finish their investment in 2001 started to purchase construction contracts. After 2001 demand decreased sharply, as there was little demand for more expensive housing. Many housing developers became bankrupt and the construction of new housing slowed down considerably. Nearly no new construction was started after 2001.

New housing starts were already excessive, thus the new regulations only added to the existing problems.

Private housing developers (in contrast to the cooperatives) emerged in the early 1990s, and started to work on a large scale. Housing purchases were financed to around 70% by cash, developers financed themselves with pre-sale contracts. Therefore, mortgage growth had little effect on the housing market.

Figure 8. Determinants of the cycle in the housing market in Warsaw in 1994–2003



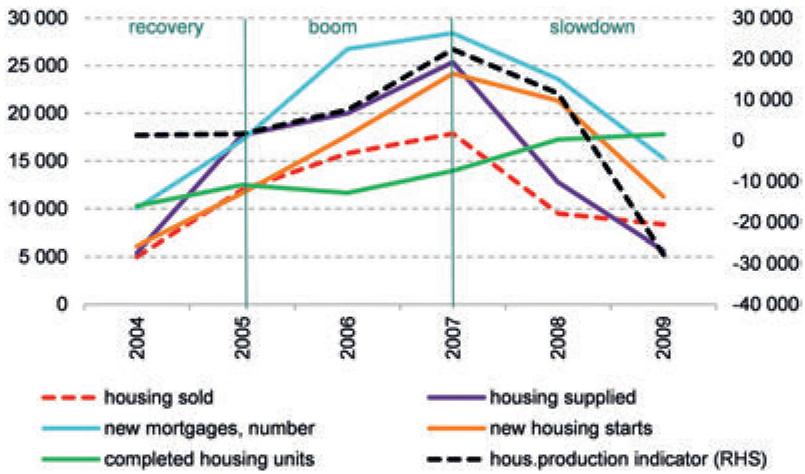
Source: own calculations based on NBP, CSO, BIK data.

The second cycle (Figures 9–11) began when Poland entered the EU in 2004. Many economic factors augmented or annihilated each other, as concerns consumers, investors, developers and banks. Only the most important ones are presented here in a simplified way. The two-digit inflation fell after 2000 to quite normal levels, and mortgage rates followed. Also foreign denominated mortgages, especially CHF ones (almost twice lower mortgage rate then PLN mortgage rate), started to emerge. Banks and their employees were interested in offering CHF mortgages, because they were very profitable, and such mortgages were indeed paid out in PLN. The decline of interest rates increased the mortgage availability. At the same time there were many new marriages, that came from the post-war baby boom. The economic activity accelerated, and the major cities observed declining unemployment rates or even a shortage in workers, especially amidst the quite high unemployment rate in the whole country. The consumer sentiment was on a rise.

The supply of housing was created by small firms, that had financial problems that arose in the past cycle. There were little projects under construction, the stock of development land was rather low.

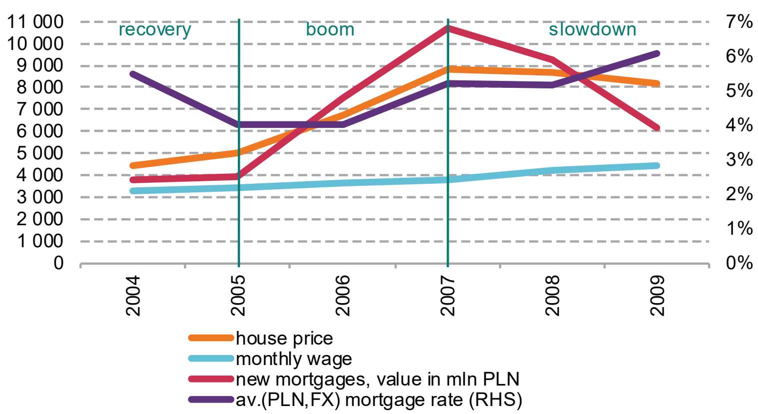
The fast increase in demand, amidst inelastic supply, lead to a strong price boom. This fueled speculative investments. Developers were selling pre-sale contracts, quite often just holes in the ground. The mortgage cost increased as prices rose, thus consumers tried to expand the maturity as much as possible. New, foreign development firms were buying contracts from incumbent firms.

Figure 9. Cycle in the housing market in Warsaw in 2004–2009



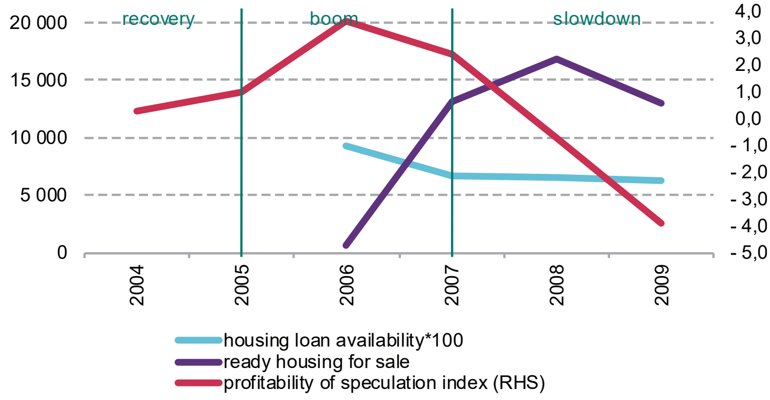
Source: own calculations based on NBP, CSO, REAS, BIK data.

Figure 10. Determinants of the cycle in the housing market in Warsaw in 2004–2009, A



Source: own calculations based on NBP, CSO, REAS, BIK data.

Figure 11. Determinants of the cycle in the housing market in Warsaw in 2004–2009, B

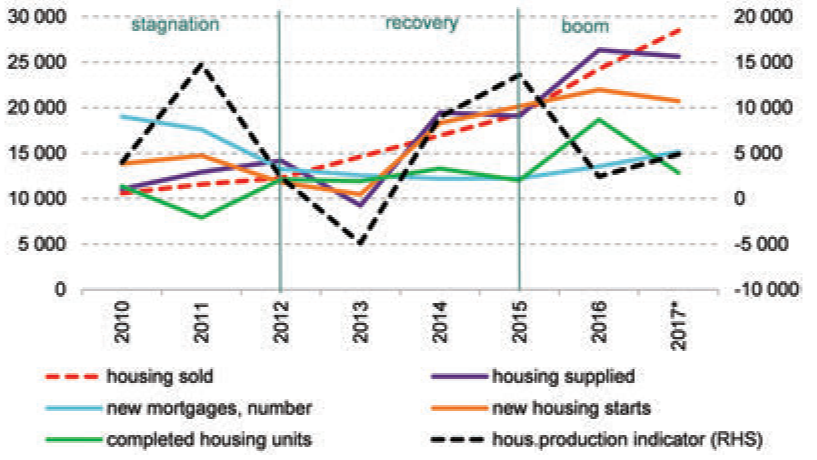


Source: own calculations based on NBP, CSO, REAS, BIK data.

The demand crash resulted from the global financial crisis, when cheap, foreign currency denominated mortgages became a rare good. The sub-prime crisis in the US also showed the consequences of an excessive lending boom. Banks that granted FX mortgages also started to have liquidity problems, and the factual mortgage rate was rising fast – only PLN mortgages were issued and banks restricted their lending. The housing demand dropped quickly, while developers increased their production. There were many unsold contracts and ready housing units on the market. Developers were able to survive, as they had now a better capitalization than they had in the first cycle. Developers also extended the time needed to finish housing units that were sold before, which was risky for the buyers. Prices were stable and no systematic problems were noted. An important improvement was that in 2006 the financial supervisory authority prohibited domestic banks to issue FX mortgages and extended this prohibition to all banks in 2013, unless the client was receiving his income in FX.

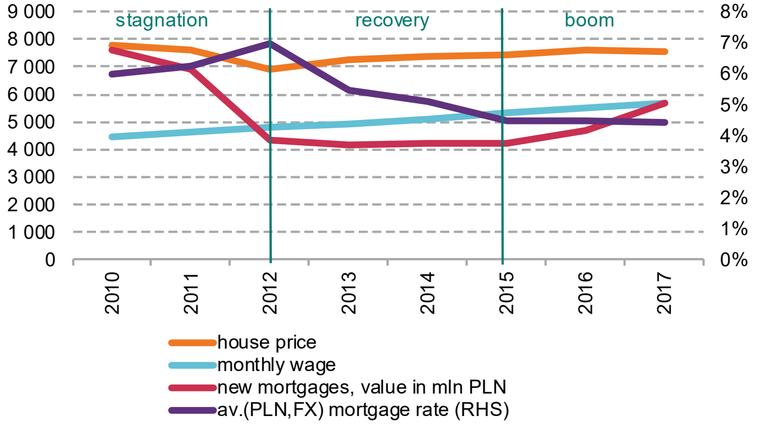
The third cycle (Figures 12–14) started in 2010, when the government increased the limit on housing subsidies. Even though the subsidies were both for the new market and the existing stock, housing on the new market gained the subsidies easier and took a major part in the whole program. The increases in the price limit lasted until 2011, and resulted in an increase of purchases of such flats. The subsidy program was stopped in 2013, but the announcement of such an decision made people anticipate their purchase. At the same time the Monetary Policy Council started a series of interest rate declines which lasted until 2016. Those lead to lower mortgage costs and also the deposit rates declined. In 2014 another subsidy scheme, aimed only at the primary market, was launched.

Figure 12. Cycle in the housing market in Warsaw in 2010–2017



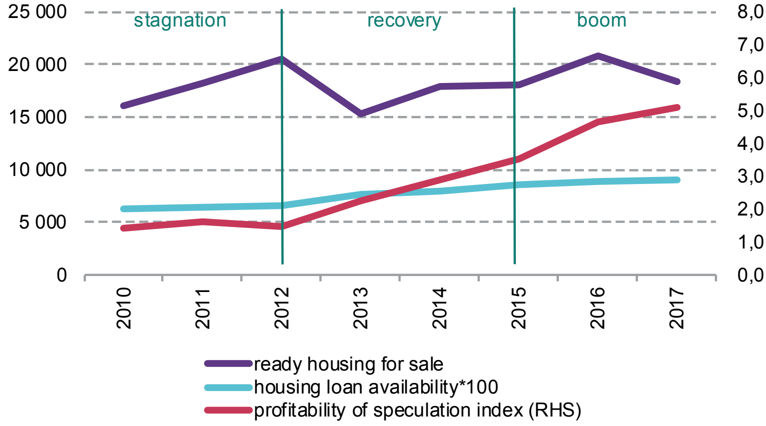
Source: own calculations based on NBP, CSO, REAS, BIK data.

Figure 13. Determinants of the cycle in the housing market in Warsaw in 2010–2017, A



Source: own calculations based on NBP, CSO, REAS, BIK data.

Figure 14. Determinants of the cycle in the housing market in Warsaw in 2010–2017, B



Source: own calculations based on NBP, CSO, REAS, BIK data.

The joint work of the fiscal and monetary stimulus lead to a fast increase in housing demand that easily exceeded the levels from the 2004–2009 boom. Supply, also on the secondary market, was elastic and prices remained stable. No speculative behavior was triggered and there was also the expansion phase in smaller cities. Mortgages were rising continuously in a stable pattern but since 2014 cash purchases have started to play a major role. Also investment purchases became important, as deposit rates were very low and the rate of return on housing investment was relatively high.

The Polish experience indicates that cycles are individual and no easily replicated. The list of potential determinants is short and well known, but their combination can lead to various unexpected scenarios.

Conclusions

The aim of this article is to stress that in order to understand housing cycles better, one needs to bear in mind that housing is a durable consumer good and an investment object at the same time. This fact makes buyers react in a seemingly irrational way, especially more housing is bought when its price increases. We use the Polish experience to show that housing cycles are quite similar, but each time can be driven by different factors. In consequence, cycles cannot be easily replicated, and in order to know how to contain a given cycle, one needs to analyze what is its current driver. While the list of potential determinants is short and well known (income, interest rates, regulations), their combination can lead to various unexpected scenarios. We find that prices rising stronger than inflation is a good early warning indicator of a potential boom.

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Chapter 4

Empirical analysis of the determinants of the housing cycle in the primary housing market and its forecast

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Introduction

A home plays an enormous role in the life of every household as a capital good that generates consumer services and an investment good that is a source of income for the future (see DiPasquale, 1992; Henderson and Ioannides; 1983 and Łaszek, 2013). The decisions of households that buy housing on the primary market depend on incomes, interest rates and prices, while the decisions of developers who produce it depend on prices and costs. An analysis of the housing market is very important because it serves a social function and can increase the wealth of the home owner. However, during boom-bust episodes it can negatively affect financial stability. A permanent feature of the housing market is its cyclicality, which can be explained by the low elasticity of supply. The financial system and consumer behavior have a pro-cyclical effect on demand. Ciarlone (2015) found by decomposing house prices into their main drivers that housing booms in Eastern Europe were mainly caused by regulations and the lack of housing in comparison to the basic needs of households, not just by speculation.

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This article presents the opinions of its authors and not necessarily the official position of the Narodowy Bank Polski. The forecasts presented in this paper are pure academic exercises which should help to understand the functioning of the market and to get insight how it could evolve in the near future.

The market is imperfect, it involves a long construction process and the market players behave irrationally. Another problem is the information asymmetry, which means that during transactions one side is better informed than the other. Problems with reliable and complete information are in many cases a result of brokers' and developers' marketing activities in mass media[4], so the buyer sees a distorted picture of the market. However, developers face positive and negative consequences of this market intransparency. They can obtain higher returns, selling homes at high prices to uninformed clients. However, it is difficult for them to plan future production when signals from the market are misleading. While demand is analyzed in various articles, the supply side is less often studied, and models of the market that could be used to make forecasts for the primary housing market are not well developed. While there is a rich literature on the forecasting of house prices (see Rahal, 2014 for a detailed review), those models do not forecast demand, supply and construction costs explicitly. In order to provide proper policy advice about the housing market, it is not enough to know how prices will evolve, but also what is driving them. Thus, supply, demand and construction costs need to be analyzed and forecasted, too. Some macroeconomic models take the housing market into account, but it usually plays a minor role. Researchers that try to incorporate housing in DSGE (dynamic stochastic general equilibrium) models need to simplify the housing market, and the supply side is usually not captured or it is ad-hoc, included just to close the model. Those models do not account for accelerator effects and frictions in the housing market, speculative behavior and finally the construction time. As Iacovelli (2010) explains, DSGE models aim to explain how housing affects consumption or how monetary policy affects the housing market. This is a great and important task, but it is also crucial to go more into the details of the housing market, such as the number of newly constructed dwellings. If DSGE models contained a fully developed housing market, they would be too complicated to be solved with state-of-the-art mathematical tools. This is understandable, as their aim is to model the whole economy and explain inflation. However, if one wants to model house price dynamics, it is necessary to understand the connections between the demand and supply side. The model introduced in this paper presents a detailed explanation of the relationships between demand, supply, costs and prices, and is useful in an analysis of the impact of changes in income or mortgage rates on house prices.

[4] Soo (2013) constructed a sentiment indicator from the tone of local housing news from 20 largest cities in the US during the 2000–2011 period. His sentiment indicator is able to predict house price booms and busts with a significant lead, which shows that mass media have a big impact on consumer behavior and affect housing demand.

The transactions in the housing market concern newly constructed housing and sales of housing from the existing stock. A detailed analysis of the relationship between these two markets can be found in Augustyniak et al. (2014a). The relationship at the city level for Poland was investigated empirically by Leszczyński and Olszewski (2017). Because supply from the existing housing stock is rigid in the short and medium term, any excessive demand translates very quickly into excessive demand for new construction (see Augustyniak et al. 2014b).

We point out some important studies that focus on the developer side in the housing market. Capozza and Helsley (1990) present a theoretical dynamic model of a growing urban area, in which land has been converted from agricultural to urban use. Developers maximize their profits by selecting the optimal time to convert land from agricultural to urban use and build houses. It is assumed that a city has potentially infinite borders, so it can expand outward from a city center (business center) to which all residents must commute. A city has an exogenous function of housing rents, fixed lot and house sizes and the authors decompose theoretically price rents into their components. Capozza and Helsley also introduced uncertainty element and claimed that it, together with the irreversibility of development, slow down the development process and could cause an increase in the value of land if the boundary of the urban area is exogenous.

Abraham and Hendershott (1996) describe and empirically verify metropolitan real price changes. They divide the determinants of real house price appreciation into two groups: one that accounts for the deviations from the equilibrium price and another that explains changes in the equilibrium price. This approach helps to explain cross sectional variation in real housing price changes in thirty US cities over the period 1977–1992.

It is important to stress that the empirical model focuses on newly constructed housing and not the whole housing stock. Adjustments of the housing stock through migration, the construction of new housing and its depreciation or destruction happen only in the long run. The division of a housing unit into two or the conversion of commercial real estate into housing is very costly, happens only on a very small scale and takes a lot of time. In the short term, increased housing needs can be satisfied only with new construction, and through rising prices, rising demand leads to construction booms. These booms end quite often in excessive debt accumulation and sometimes in banking crises that are accompanied by an economic slowdown (see the case of the US, Spain and Ireland discussed in André, 2010, André, 2011 and Cerutti et al., 2015). Mishkin (1995) stressed that mortgage financing affects housing market through 'banking lending' and 'balance sheet' channels. Changes in monetary policy affect the availability of households debt and asset prices.

The aim of this paper is to forecast house prices, construction costs, demand and supply, thus the whole housing market. A housing model we use is based on the Augustyniak et al. (2014a) model and the dynamics of the primary housing market are explained with a simple four-equation model of housing supply, demand, price and construction costs. The model replicates historical data well, and it is applied to predict the future value of house prices, demand, supply and costs in the next two years on a quarterly basis. The economy has a direct impact on the housing market, while the effects of the housing market feed through the labor market and the banking sector with a certain delay to the economy and might be non-linear. Therefore, the whole economy is taken as given and the official NBP NECMOD[5] forecast is used (see NBP 2018).

The paper is organized as follows. A brief overview of the Polish housing market is presented in section 1. The empirical analysis of the dynamic housing market model and the out-of-sample forecasting tests are performed in section 2. The forecast of house prices for the next two years is presented in section 3, while section 4 concludes the paper.

1. A short overview of the Polish housing market

After the Second World War, the housing stock in Poland was to a large degree destroyed and the socialistic system never managed to satisfy the needs of households. Since the change to the market economy, the primary market has become very important in Poland, as it contributes to growth of the housing stock and helps to satisfy the growing need of households to possess an apartment. The transformation changed significantly the size and investor structure of construction in Poland. The share of the private sector grew, while the share of housing cooperatives, company and communal housing fell. This was possible due to changes in the law, but also due to the emergence of banks that issued housing loans on a large scale.

Since the beginning of the 1990s, together with the withdrawal of the state from pursuing housing construction and its gradual withdrawal from funding too, a new form of housing developers has emerged. These companies realized investments at the risk of future homeowners and with the funds provided by them (prepayments), supplemented sometimes with loans. The investments were often risky for the clients and very profitable for the developers. The risk associated with

[5] NECMOD is a structural macroeconometric model of the Polish economy, see Budnik et al. (2009).

this form of activity was an important factor that limited construction demand. In 2012 a law to protect buyers of developer housing was introduced.

The transformation of the production sphere had a positive impact on the housing construction sector in the long term, eliminating large state enterprises and expensive, poor quality production based on prefabricated technology. However, the changes in the basic proportions of the housing market, such as the private source of funding, changes in the price-to-income ratio of newly-built apartments, inflation and unemployment, and the collapse in the availability of credit affected housing demand, causing changes in construction size.

In the long term, the whole economy and the developer sector adopted to the new needs, and consequently new projects were started on a larger scale. First of all, developers and new technologies appeared. The market structures of housing construction developed, especially in the largest cities in Poland, and its financing was privatized, which was a consequence of the withdrawal of the state from successive programs subsidizing housing construction. The first program that subsidized the owner-occupied housing segment, *Family on its own* (RnS[6]), was introduced in 2006. It operated in a pro-cyclical manner, strengthening the excessive increase in prices, bordering on a price bubble, and was abandoned in 2012. In 2014 the *Housing for the young* (MdM[7]) program was introduced. The main change in the MdM program was that households could not buy a subsidized flat from the secondary market until late 2015. The RnS program cut the interest rate by half for the first eight years of the loan duration. The MDM program is a down-payment subsidy, up to 30% of the loan value. It decreases the loan instalments and thus makes mortgage financed housing more affordable. Both subsidy schemes do directly or indirectly decrease the interest rate that the owner has to pay, but they can only be used for mortgage-financed housing purchases. According to NBP (2013, 2015) both programs increased the demand for loans and also had a positive impact on house prices.

The structure of the investment sector of developers changed with Poland's accession to the European Union and the credit boom in the years 2005–2008. The EU accession in 2004 resulted in an inflow of foreign capital, while the easy access to foreign financing, stable inflation and growing income caused strong demand for

[6] RnS – (Rodzina na Swoim; Family on its own) – the government program intended to support the housing sector through subsidies to interest rates on housing loans. The program was introduced in 2006 and closed at the end of 2012.

[7] MDM – (Mieszkanie dla Młodych; Housing for the young) – the government-subsidized program intended to support housing construction through subsidies for housing loans, entered into force at the beginning of 2014 and closed at the end of 2018.

housing. The market concentration of developers in the largest cities was growing. Developers bought land banks large enough to build housing for six years without the need to buy more land. Governmental procedures were introduced that speed up the preparation of land for investment. As a consequence, the limited access to development land has been eased. The years 2005–2008 were characterized by a boom on the mortgage market and the beginnings of the creation of standards and regulations of this market. From the beginning of the outbreak of the global financial crisis to 2013, important financial supervision regulations were introduced which restricted access to credit (Recommendation S, Recommendation T, and Recommendation J).

The years 2002–2014 left many housing issues unresolved, mainly in the sphere of social housing (after the expiry of the Social Building Society TBS[8] program) and rental housing, but also mortgage lending, remained a problem. Twenty five years after the transformation, the state has not settled the issue of the rental market and social housing for the poorest, and the demand for owner-occupied housing from the primary market is still large. The rental market is tiny, mostly restricted to the largest cities and in many cases operates in the grey-zone (see Augustyniak et al., 2013). The dominant share of owner-occupied housing was obtained by the current owners in socialistic times, and there is little trade of those dwellings. As the NBP's (2015) empirical analysis shows, even controlling for the GDP per capita differences, CEE countries lack around 50 housing units per 1000 inhabitants to meet the EU average, which is around 340 housing units per 1000 inhabitants. This excessive demand can be satisfied only with new construction.

2. Estimation of the housing demand and supply dynamics

The estimation of the housing market bases on the above presented micro-founded model and the work of Mayer and Somerville (2010), Steiner (2010) and Augustyniak et al (2014b). The time-series that are available for most countries do not allow us to estimate the previously presented micro-models directly. The housing demand equation cannot be transformed into a log-linear equation, thus

[8] TBS (Towarzystwa Budownictw Socjalnego; Social Building Society) – a company operating under the Act of 26 October 1995 on certain forms of subsidizing housing construction, the subject of which was housing construction and maintenance based on rental, provision of management and administration services and conducting business related to housing construction and accompanying infrastructure. The TBS offer was planned to be addressed to non-affluent families eligible for a loan subsidy from the National Housing Fund (KFM).

non-linear estimation methods are used. There are some parameters that were estimated jointly and there is no auxiliary data to disentangle the parameters. A reasonable approach is to rewrite the model with log-linear equations, which correspond to the initial micro-funded equations. As in Mayer and Somerville (2000), log-linear models of supply and demand that describe the number of housing units placed and sold on the market are estimated.

Housing cycles are driven by excessive increases in housing demand, thus the analysis starts by explaining the dynamics of housing demand. Throughout the article, housing is financed with the use of a mortgage, thus households need to bear the cost of monthly loan instalments. Households use their income for the loan repayment[9] and the consumption of other goods. According to Henderson and Ioannides (1983) and Łaszek (2013) housing is bought for consumption and investment purposes. To capture the latter purpose, the appreciation of housing $A = \frac{p_t}{p_{t-1}}$ is included in the utility function. Consumers form extrapolative expectations and rising prices make housing a more desirable good (see Dunsky and Follain, 1997, Somerville et al., 2010, Lambertini et al., 2012, Hott, 2012, Salzman and Zwinkels, 2013).

The first equation describes the aggregated housing demand (HD_t):

$$HD_t = \alpha 1 + \alpha 2 * P_t + \alpha 3 * D(P_t) + \alpha 4 * Intrate_t + \alpha 5 * Income_t + \epsilon_t, \qquad (1)$$

Here *Pt* is the log house price, $D\ (P_t)$ is the rate of house price growth. The interest rate ($Intrate_t$) and income in log terms ($Income_t$) account for the changing economic situation. The empirical results (see Table 1) show that there is a positive relation between aggregated demand and income and a negative one in the case of prices and interest rates. As expected, the appreciation has a positive effect on housing demand.

The next step is the estimation of the supply in the primary housing market. Wheaton et al. (2001) and Hendershott et al. (2002) state that housing producers base their decisions on past information. Housing supply is a crucial factor in the housing boom but unlike the demand side it has received little attention in the literature. There are studies on the supply of housing such as Muth (1960), Smith (1976), DiPasquale (1999), Epple, Gordon and Sieg (2010), but most of the studies

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[9] Prudential regulations set a maximum limit of the monthly loan service to the income, to curb excessive housing demand.

do not go into empirical details about producers' decisions concerning at which point in time to start the development process and at what scale. A notable exception is Bulan et al. (2009), who study irreversible investment decisions in Canada. The biggest obstacle to the empirical analysis of housing supply at the company level or even the city level is the lack of data on individual developers and their cost functions. The costs of a developer at each stage of the construction process are described in detail in Augustyniak et al. (2014b). Taking into account the factual development process, the average housing supply function is analyzed.

For the analysis of housing dynamics at the city level, it is enough to understand that developers are profit maximizers who choose the optimal amount of land and housing quality. Developers form extrapolated expectations (see Wheaton et al., 2001 and Hendershott et al., 2002), thus they increase their production if their short-term profits increase and if they assume that house prices will rise further.

Grimes and Aitken (2010) discuss whether one can assume that construction costs are proportional to land costs, but our observations and also data presented in the detailed analysis of housing construction costs presented by NBP (2014a) indicates that this assumption has strong empirical basis. If house demand rises, developers need to buy more land, which becomes more expensive. At the same time the demand for workers and construction material increases, thus total construction costs rise. Such an approach is used by Glaeser and Gyourko (2006) and Glaeser, Gyourko and Saiz (2008).

The housing supply is the number of dwellings put on the market in a given quarter and is estimated as follows:

$$HS_t = \beta 1 + \beta 2 * D\left(P_{t-4}\right) + \beta 3 * D\left(PC_{t-4}\right) + \beta 4 * LHD_{t-4} + \\ + \beta 4 * GFC\_shock_{t-4} + \epsilon_t \quad (2)$$

The constant $\beta 1$ captures the autonomous production, a particular number of housing units that will be produced regardless of current prices or costs (see Augustyniak et al., 2012). Based on empirical observation, the lagged price (by one year) is included ($D(P_{t-4})$). Producers of dwellings react directly to price increases and start new constructions but those dwellings will be delivered to the market in the form of pre-sale contracts one year later. Higher construction costs lagged by one year $D(PC_{t-4})$ and lagged interest rates $D(Intrate_{t-4})$, lower the developers' willingness to begin new projects. The interest rates inform developers about consumers' financial capability, which determines their ability to buy housing. Higher interest rates also cause higher alternative costs of investments in real estate.

The price adjustment mechanism is estimated in equation 3. The house price dynamics depends mainly on its lagged levels, so $D(P_t)$ depends on its past realizations $D(P_{t-1})$. Moreover, as in Tse, Ho and Ganesan (1999) prices react with a one quarter lag to the supply and demand mismatch[10] ($HS_{t-1} - HD_{t-1}$). Excessive demand makes prices rise, while they start to fall under excessive supply.

$$D(P_t) = \vartheta 1 + \vartheta 2 * D(P_{t-1}) + \vartheta 3 * (HS_{t-1} - HD_{t-1}) + \epsilon_t \quad (3)$$

Asymmetric price adjustment reactions were tested for, but it turned out that the price increase in response to excessive demand is as strong as the price decrease in response to excessive supply. One could expect prices to decline faster than they rise, which would help developers to reduce the stock of unsold housing and make the market move back to its equilibrium. However, developers lower their price expectations slowly, looking to find a buyer that will be willing to purchase the dwelling for the high price. When dwellings are financed with credit, the loan agreement would refrain housing producers from reducing prices below a certain level. Purchasers could negotiate the price, but they have very little negotiation power and not enough information about the number of unsold housing units in a given location. Housing producers are not interested in lowering the price and amidst oversupply they still place new dwellings on the market. To some extent this is the result of projects which are under way and cannot be stopped (see Grenadier, 1996, Łaszek and Olszewski, 2014).

The construction cost dynamics $D(PC_t)$, which affects the start of new construction is estimated in equation 4. The costs increase depends strongly on its past realization $D(PC_{t-1})$. Moreover, construction costs grow with house supply increases ($D(HS_{t-1})$), as more input goods are needed and their cost increases.

$$\mathrm{PC_t} = \rho 1 + \rho 2 * \mathrm{PC_{t-1}} + \rho 3 * \mathrm{HS_{t-1}} + \epsilon_\mathrm{t} \quad (4)$$

The four equations presented above describe the dynamics on the housing market. For the empirical analysis, quarterly data for the Warsaw primary housing market are applied and to cope with short-term shocks the four-quarters moving average is used. It is Poland's biggest market, with the highest number of transactions. It has higher price levels, although it behaves in a very similar way to the markets in other Polish cities (see Baldowska et al., 2013 and NBP, 2015). Conclusions from

[10] Indeed this is the same as the adjustment of the stock of unsold housing, which evolves as $Stock_t = Stock_{t-1} + HS_t - HD_t$, thus its change $\Delta Stockt$ equals $HS_t - HD_t$.

Table 1. Regression results of the determinants of aggregate supply, demand, prices and production costs

	LHD_t	LHS_t	$D(LP_t)$	LPC_t
LP_t	**–0.630 ****** (0.233)			
$D(LP_t)$	**7.755 ****** (1.108)			
$D(LP_{t-1})$			**0.806 ****** (0.072)	
$D(LP_{t-4})$		**2.125 *** (1.238)		
$Intrate_t$	**–17.417 ****** (3.137)			
GFC_shock		**–0.908 ****** (0.112)		
$LIncome_t$	**1.859 ****** (0.198)			
LPC_{t-1}				**0.898 ****** (0.031)
$D(LPC_{t-4})$		**–5.273 ****** (1.469)		
LHD_{t-4}		**0.964 ****** (0.101)		
$D(LHS_{t-1})$				**0.018 ****** (0.006)
$LHS_{t-1} – LHD_{t-1}$			**–0.029 ****** (0.009)	
C	**–1.010** (2.183)	**0.414** (0.822)	**0.001** (0.002)	**0.705** (0.262)
Adj. R^2	0.82	0.80	0.74	0.94

*Standard errors in brackets, ***, **, * significant at: 1%, 5% or 10%. Symbols: L – logarithms, (t-i) – lagged variables, D – first differences.*

Source: own calculations.

the Warsaw market are therefore applicable to the markets of the other large cities. The house prices (P_t) originate from the NBP database BaRN. The number of housing units sold and placed on the market (HD_t, HS_t) comes from REAS data[11].

[11] REAS is a consulting company providing services related to the housing market.

Sekocenbud[12] is the source of the construction costs (PC_t). The Central Statistical Office (GUS) provides data on income in the private sector ($Income_t$) and the mortgage rate ($Intrate_t$) is calculated based on NBP data. The supply, demand, price, income and construction costs time series are in logarithms. Because the REAS data starts only in 2007 Q1, it is extended with the dynamics of GUS data on completed housing, lagged by eight quarters. It takes around two years between the date at which the pre-sale contract is sold and the moment that the housing unit is completed. All equations were estimated jointly on quarterly data for 2006 Q1–2017 Q4, using the OLS regression, correcting for heteroskedasticity and autocorrelation.

The empirical results indicate that constantly low interest rates or increasing incomes lead to a demand boom, which in turn causes price increases and a supply boom. When income and nominal housing prices rise at the same pace, relative house prices remain stable, and the housing boom can last for a long time. It can be stopped only by a huge shock (for example the sub-prime crisis in the US), which forces banks to constrain the disbursement of mortgages.

3. Forecasting of house prices

The housing cycle model is used to forecast house prices. It is based on four endogenous variables (demand, supply, costs and prices) and two exogenous variables (mortgage rates and income). The historical data used in the analysis comes from the NBP database BaRN, REAS, GUS, and Sekocenbud, as described in chapter 2. The equations are recursive, which allows future values to be calculated basing on their past realizations. The two exogenous variables (the interest rate and economic growth) stem from the NECMOD projection (see Budnik et al., 2009) and are published in the Inflation Report of the NBP (2018). The income is assumed to grow at the same pace as GDP growth. Interest rates are always set constant over the forecast period, thus the mortgage rate is also constant. The housing forecast covers the next three years on a quarterly basis until the end of 2020.

The root mean squared error of the forecast (RMSE), calculated on past forecast errors is presented in Table 2. The forecast results were transformed from logs to normal numbers, which makes it easier for the reader to interpret the results. It should be highlighted that the accuracy of the four equations is tested for, while the literature review by Rahal (2014) indicates that only the accuracy of the price

12 Secocenbud is a source of information concerning prices in the building industry.

forecast is measured. We do so, because we want to show how the whole model performs. The model forecast is confronted with a very simple AR(4) model, in which the growth of each variable under inspection is explained by its lagged growth, up to four lags. The unpleasant finding is that the simple AR(4) model outperforms the structural model as concerns the price development. Especially in the long horizon the root mean squared error of the structural model is nearly as twice as high as that of the simple AR(4) model. Also its seems that the housing demand can be better forecasted with the AR(4) model in the short run, while in the long run both methods perform in a similar fashion. The strong point of the model is the prediction of the housing supply and construction costs. One possible explanation for this situation is that producers behave in a quite logical and predictable way, while house purchasers are affected by factors which we do not capture in our model. Such factors include for example housing subsidies and mortgage restrictions. And finally, the structural model is primarily created to understand the mechanism of the market, which is by definition impossible in the AR(4) model, as each variable is completely independent of the other variables.

Table 2. Root mean squared error (RMSE) of the forecast, based on out-of-sample forecasting for the four-equation model (left panel) and the AR (4) model (right panel), for the whole forecast horizon

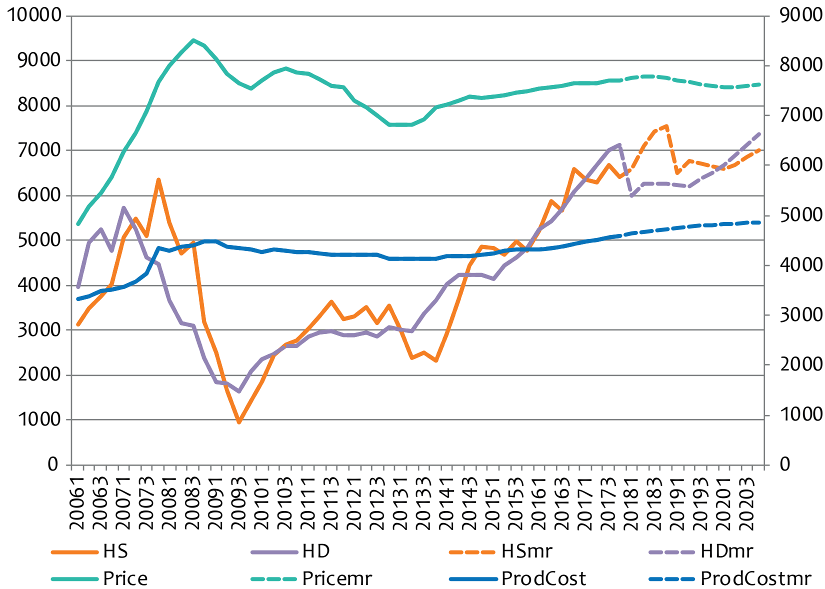
Forecast horizon	HS-dev	HD-dev	P-dev	PC-dev
1	613	997	111	76
2	636	1008	245	102
3	635	1204	435	118
4	622	1381	715	126
5	1070	1541	1030	132
6	1089	1684	1324	137
7	1421	1550	1626	145
8	1696	1476	1879	146

Forecast horizon	HS-dev	HD-dev	P-dev	PC-dev
1	528	274	109	86
2	848	480	229	135
3	1174	701	373	183
4	1603	973	551	225
5	1732	1160	704	270
6	1865	1333	834	320
7	2022	1497	959	364
8	2034	1624	1046	383

Source: own calculations.

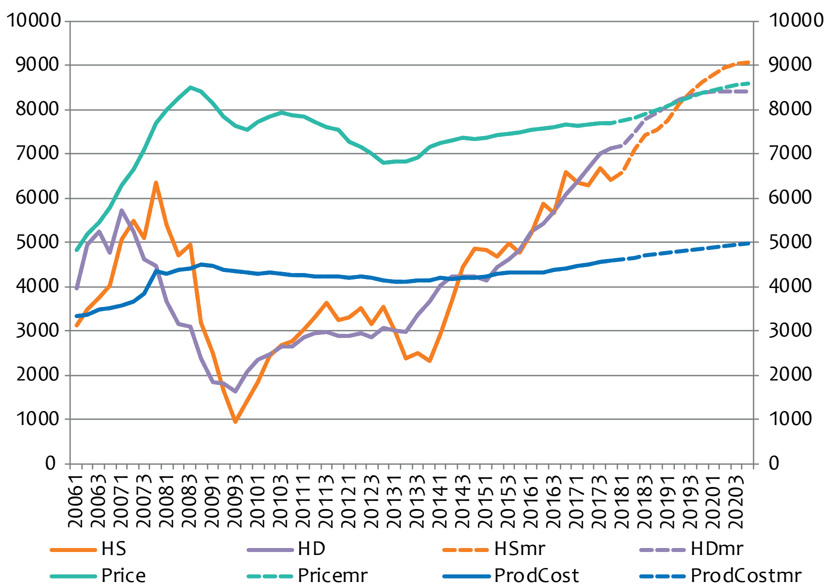
The first forecast is based on the assumption that interest rates are stable and income grows as forecasted by NBP (2018). We would like to point out that our forecast is an academic exercise only and is used to demonstrate how our model could be used to get more insight about the market. According to the baseline scenario demand should decline a little bit, to reach a level which is consistent with the current price and income levels. Supply should first increase, but after few quarters it should follow demand and start to decline, too. As a result of the over-supply, house prices should decline slightly. On the other hand, construction costs should continue to increase to a limited extent. The observations of the market do not point at a demand decline, at least not for the nearest future. Demand declines in our model because it captures owner occupied housing demand, while over the last two years we observe an increasing investment demand, which means that households buy a flat in order to rent it. However, so far there is no official data for this fact, the evidence is anecdotal and we obtained it from news. In short, there is additional demand which is not captured in the model and cannot be forecasted by it. We tried to add variables like the profitability of renting in relation to the return of government bonds or the deposit rate, but the period is only around eight quarters and we did not obtain meaningful results. One solution would be to subtract the consumption demand that our model generates from the factual data over the last two years and try to explain the residual, which should be the investment demand. Currently, however, the analyzed period is too short to make reliable inferences. A possible resolution would be to use the information from the news and make an expert correction. According to news, around 20% of demand is currently of investment type. So we add the 20% of investment demand on top of the consumption demand which the model predicts. The results are presented in Figure 2. Under such a scenario demand should continue to grow, however it will slow down at some point. This happens, because supply starts to lag behind, thus house prices continue to increase. Construction costs should increase, too. We cannot say what will happen in the future, but at least our model can be used to make simple simulations, which should be augmented with expert knowledge. What is important is the fact that our endogenous variables interact with each other. If one only tries to forecast house prices alone, the interdependencies between the other variables are neglected. Such a situation is depicted in Figure 3, in which the forecast of the AR(4) model is shown. Under such a model we should observe a rise of demand and prices, while new housing supply grows only by little. Because there is no link between supply, demand and prices, the AR(4) housing market will hardly reach an equilibrium, which should happen in the long run. One idea is to create a mixture of the four equation model and the AR(4) forecast or even other models, to get a more reliable forecast result. But this is beyond the scope of this paper.

Figure 1. Forecast of housing demand, supply, house prices and construction costs (dashed line)



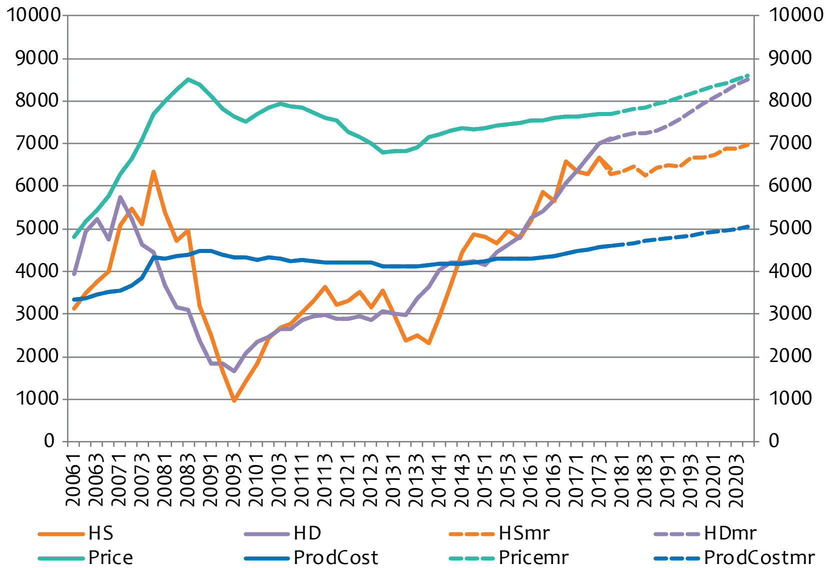
Source: own calculations, based on NBP, GUS, REAS and Sekocenbud data.

Figure 2. Forecast of housing demand, supply, house prices and construction costs (dashed line), 20% of the consumption demand is added as a proxy for potential investment demand for housing



Source: own calculations, based on NBP, GUS, REAS and Sekocenbud data.

Figure 3. Forecast of housing demand, supply, house prices and construction costs (dashed line) with the AR (4) model



Source: own calculations, based on NBP, GUS, REAS and Sekocenbud data.

The observed values are presented as solid lines and the dashed lines show the predictions. Prices should first decline and then increase slightly, while costs should be relatively stable in the future. Supply should rise for a short period and then decrease sharply. Demand should fall in the next quarters and increase gradually from the middle of 2015. As stated earlier, housing policy has a strong effect and changes in the housing subsidy scheme can have a significant impact on demand. Also, potential changes in interest rates will change the demand and supply of housing. The forecast should be understood only as an academic analysis and an indicator that tells in which direction the housing market will evolve. It should not be used to make investment decisions, because external interest rate shocks, large capital flows or unexpected changes in housing policy and growth of the economy can affect the market.

Conclusions

The four equation model describes the main drivers of housing demand and supply in the primary housing market in Warsaw. Housing demand is mainly driven by rises in income and interest rate declines. Contrary to what would be expected, the appreciation of housing boosts its demand. Housing supply rises if increases in prices are higher than increases in construction costs.

The four equation model replicates the real dynamics of the housing market well, which is confirmed by the results of the out-of-sample forecasting exercise. This model can be used to forecast the behavior of the housing market for the next two years on a quarterly basis. As it can be easily replicated, the model should be useful for policy makers, central banks and regulators to test how changes in mortgage rates or income affect prices, demand and supply in the primary housing market. The forecast results should be augmented with expert knowledge about the market.

The model focuses only on the primary market, thus further research should incorporate the secondary market. The inclusion of the rental market could be another improvement of the model, but at this stage the aim is to provide a quite simple model that provides an understanding of where housing booms and busts come from.

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Chapter 5

A guide to early warning models for real estate-related banking crises

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Introduction

The recent financial crisis showed how unfavorable developments in real estate markets can significantly contribute to financial instability. Financial and economic busts preceded by an excessive real estate boom are particularly harmful from a financial stability perspective since they are longer and costlier than the average downturn (see Claessens et al., 2009, Jordà et al., 2015). This stems from the central role of the real estate sector in the economy (see ESRB, 2015): real estate assets represent a relevant share of households' wealth, the construction sector is a key contributor to economic activity, and investment in housing is typically bank-financed. The materialization of real estate vulnerabilities, triggered for example by a steep fall in house prices, could result in a banking crisis by entailing specific losses in banks' mortgage loan portfolios, as well as in a general slowdown of economic activity by negatively affecting households' wealth and construction firms' profitability. Against this backdrop, designing and operationalizing macroprudential instruments aimed at real estate markets is a key issue for European authorities.

Instruments such as risk weights for real estate exposures, limits to loan-to-value (LTV) and debt service-to-income (DSTI) ratios are considered important macroprudential tools for targeting real estate risks. Their effectiveness, however, depends on their timeliness. Macroprudential measures seem to be more effective

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when they are timely[3], based on early warnings from monitoring appropriate indicators. The operationalization of such instruments therefore requires identifying reliable indicators (and associated thresholds) signaling well in advance excessive developments in the real estate sector.

Early warning models (EWMs) are econometric models aimed at identifying vulnerable periods in the run-up to a crisis i.e., a situation where imbalances accumulate making the crisis more likely. These models are therefore not concerned with the exact prediction of the start of the crisis, but rather on the detection of the vulnerable state that might lead to crises.

The literature on EWMs has evolved according to the type of crisis of interest: the first studies concerned currency crises in emerging economies (see Frankel and Rose, 1996) whereas more recent work has focused on banking crises (see Betz et al., 2013; Alessi et al., 2014). In particular, a special attention has lately been devoted to early-warning models as starting point for the operationalization of macroprudential policies, such as the countercyclical capital buffer (see Drehmann et al., 2011; Behn et al., 2013; Drehmann and Juselius, 2014; Detken et al., 2014). Few EWMs have instead been implemented to the early identification of real estate-related banking crises (see Ferrari et al., 2015, Ciocchetta et al., 2016).

Although EWMs have an undoubted usefulness for policymakers within the risk assessment framework, their operationalization in the real estate context is hampered by several challenges. The remainder of the paper highlights the issues that arise in the implementation of an EWM for real-estate related banking crises, concerning in particular the data requirements (section 1), the modeling and evaluation techniques (section 2), the forecasting exercise (section 3). Finally, we conclude by presenting further steps that could improve the early warning methodology (section 4).

1. Data requirements

1.1. Left-hand-side variable: how to define a real-estate related banking crisis?

A crucial element in the assessment of the early warning properties of indicators is the distress event against which their signaling performance is evaluated. As the

[3] See for example the Special Feature "A recent experience of European countries with macroprudential policy" in ECB Financial Stability Review, May 2014.

indicators are designed to issue timely signals on a particular risk to financial stability that the policymaker aims to mitigate, the event should reflect the materialization of such a risk. A large part of the early warning literature focuses on a binary indicator for the occurrence of banking crises. Our earlier work (Ferrari et al., 2015), focused on real-estate related banking crises i.e., banking crises that originate from and/or are amplified by the materialization of risks stemming from the real estate sector.

For this purpose, we relied on a quarterly dataset of real estate-related banking crises compiled by the European Systemic Risk Board (ESRB) for the 28 EU Member States before and during the global financial crises (1970-2012). This database defines banking crises as episodes characterized by significant signs of financial distress in the banking system, such as bank runs in relevant institutions, losses in the banking system (non-performing loans above 20% or bank closures of at least 20% of banking system assets) or significant public intervention in response to or with the aim of avoiding the realization of losses in the banking system. This database has been refined by national central bank and supervisory experts by (1) excluding crises that were not systemic, (2) excluding systemic banking crises that were not associated with a domestic credit/financial cycle, (3) adding periods where domestic developments related to the credit/financial cycle could well have caused a systemic banking crisis had it not been for policy action or an external event that dampened the financial cycle, and (4) narrowing down only systemic banking crises stemming from real estate[4]. The starting dates of the identified real estate-related crisis episodes for the 18 EU countries involved are shown in the second column of Table 1.

Given the discretion involved in crisis dating exercises, as well as in the narrowing down of the broad set of banking crises to real estate-related banking crises, the list of crises in the ESRB dataset can be compared with that in Laeven and Valencia (2012), which is a common reference in the literature and encompasses a broader spectrum of bank distress events. This comparison allows to: (i) cross-check the crisis dates in the ESRB dataset; (ii) make a distinction between real-estate related banking crises on the one hand, and other banking crises on the other hand.

The third column of Table 1 presents the starting dates of the banking crises identified in Laeven and Valencia (2012). A comparison with the dates in the second column shows that the ESRB has identified four additional banking crises, namely in Denmark (1987), France (1993), Lithuania (2008) and the United Kingdom (1990). Furthermore, for two crises (the recent financial crisis in Spain

4 Real estate crises can vary according to the real estate segment they originate from: residential, commercial or both. In the ESRB dataset, one crisis is classified as "only residential real estate-related" (the most recent Swedish crisis), while the remaining ones are labelled as "both residential and commercial".

and the early nineties crisis in Sweden) the starting year differs between the two datasets. The list of thirteen real estate-related banking crises in the ESRB dataset is shown in the fourth column of Table 1, whereas in the fifth column we listed seven crises included in Laeven and Valencia (2012) that are not real estate-related banking crises.

To assess robustness against potential misclassifications of real estate-related banking crises in the ESRB dataset, we derive an alternative list of banking crises arising from the real estate sector based on the crises in Laeven and Valencia (2012) only. In particular, we define as our alternative measure those crises in Laeven and Valencia (2012) for which yearly real house price growth is lower than or equal to –5% for at least one quarter in the period ranging from four quarters before to four quarters after the crisis onset. The resulting lists of nine real estate-related banking crises are presented in the sixth column of Table 1. Nevertheless, in defining these alternative real-estate related crises dates a potential problem of circularity could occur in the EWM since, on one side, an observed banking crisis is defined as real estate related based on house price variation and, on the other side, house prices are evaluated as potential early warning indicators.

The previous discussion clearly illustrates the potential issues that arise when defining real-estate related banking crises, also because these are (fortunately) relatively rare events. In the ESRB dataset few countries recorded two real-estate related banking crises (Denmark, Sweden and UK), while others are considered non-crisis countries (Austria, Belgium, Czech Republic, Germany, Greece, Italy, Portugal and Slovakia). At the European level, with a total of thirteen real-estate related banking crises, the classic pooled binary logit EWM has been estimated and evaluated for the crisis countries (see Ferrari et al., 2015). For non-crisis countries, instead, no country level evaluation of the pooled EWM is possible since no true positive rate (i.e., the share of correctly identified crisis episodes) can be calculated. Nevertheless, periods of banking distress resulting from the real estate sector could alternatively be analyzed on the basis of continuous variables. Ciocchetta et al. (2016) develop an EWM for Italy, relying on a continuous vulnerability indicator, represented by the ratio between the annual flow of new bad debts related to the real estate sector and banks' capital and reserves[5]. This indicator measures the systemic vulnerability of the Italian banking system by taking into account not only the evolution of real estate exposures' riskiness but also their impact on banks' balance sheets.

[5] The indicator has been calculated separately for households on one side and business firms engaged in construction, management and investment services in real estate on the other, because of the different magnitude of the risks the two sectors pose to financial stability.

Table 1. Starting dates of real estate-related and other banking crises

	Crisis dates in external sources		Crisis dates used: selection based on ESRB dataset and Laeven and Valencia (2012)		Crisis dates used: alternative real estate-related based on Laeven and Valencia (2012) only
Country	ESRB dataset	Laeven and Valencia (2012)	Real estate-related	Other	Real estate-related
Austria		2008		2008Q3	
Belgium		2008		2008Q3	
Czech Rep.					
Denmark	1987Q1		1987Q1		
Denmark	2008Q3	2008	2008Q3		2008Q3
Finland	1991Q3	1991	1991Q3		1991Q3
France	1993Q3		1993Q3		
France		2008		2008Q1	2008Q1
Germany		2008		2008Q1	
Greece		2008		2008Q1	
Ireland	2008Q3	2008	2008Q3		2008Q3
Italy		2008		2008Q3	
Latvia	2008Q4	2008	2008Q4		2008Q4
Lithuania	2008Q4		2008Q4		
Netherlands	2008Q3	2008	2008Q3		
Portugal		2008		2008Q3	
Slovakia					
Spain	2009Q2	2008	2009Q2		2008Q4
Sweden	1990Q3	1991	1990Q3		1991Q1
Sweden	2008Q3	2008	2008Q3		2008Q3
UK	1990Q3		1990Q3		
UK	2007Q3	2007	2007Q3		2007Q3
No Crises	13	16	13	7	9

Notes: Starting date quarters were assigned to the Laeven and Valencia (2012) crises not included in the ESRB dataset on the basis of Anundsen et al. (2016) and Behn et al. (2016). The alternative measure of real estate-related banking crises is defined as those crises in Laeven and Valencia (2012) for which yearly real house price growth is lower than or equal to –5% for at least one quarter in the period ranging from four quarters before to four quarters after the crisis onset.

1.2. Right-hand-side variables: cyclical and structural indicators

Early warning indicators are economic or financial variables that inform policymakers in a timely manner on the build-up of vulnerabilities that could lead to a particular distress event. In the construction of the dataset of potential early warning indicators a trade-off usually arises between, on the one hand, the desired coverage of vulnerabilities captured by the wide variety of indicators that are found to perform well in the literature and, on the other hand, the need for sufficient data availability across the EU countries and time.

Four classes of potential early warning indicators are typically considered in the literature:

– non-financial private sector indebtedness indicators: high indebtedness of the non-financial private sector increases its vulnerability to economic shocks, raising the likelihood of large losses for the banking sector during an economic downturn. Early warning indicators measuring private sector indebtedness identified in the literature include the credit to GDP ratio (see Behn et al., 2016) and the debt service ratio (see Detken et al., 2014; Drehmann and Juselius, 2014).
– credit cycle variables: these variables reflect growing optimism in economic boom periods, which may lead to risk illusion and excessive risk-taking by financial actors. An economic downturn following a period of excess credit growth can lead to large losses in the banking sector, which may result in a procyclical amplification of the downturn when banks take action to restore their balance sheets. The early warning literature has identified a number of cyclical credit indicators that signal banking crises well in advance, including the deviation of credit to GDP from its long-run trend (see Babecký et al., 2014; Drehmann and Juselius, 2014; Detken et al., 2014; Behn et al., 2016), the deviation of household credit/non-financial corporation credit to GDP from its long-run trend (see Detken et al., 2014; Anundsen et al., 2016), total or bank credit growth (see Schularick and Taylor, 2012; Anundsen et al., 2016; Behn et al., 2016), household credit/non-financial corporations credit growth (see Büyükkarabacak and Valev, 2010; Detken et al., 2014).
– real estate price variables: financial crises are often preceded by a period of mutually reinforcing credit and asset price dynamics[6]. High lending and excessive liquidity can drive up asset prices; this can push up collateral value and potential risk illusion by financial actors, further fueling upward credit developments. Therefore, excessive dynamics in financial and asset markets may indicate the build-up of widespread imbalances. The literature has found variables related to developments in the real estate sector to be useful early

[6] On the interplay between mortgage loan financing, leverage, real estate prices and the macroeconomy, see for example Kyotaki and Moore (1997), Aoki et al. (2004), Davis and Heathcote (2005), Iacoviello (2005), Geanakoplos (2010), Iacoviello and Neri (2010), Forlati and Lambertini (2011), Kannan et al. (2012).

warning indicators (see Barrell et al., 2010; Reinhart and Rogoff, 2013; Detken et al., 2014; Anundsen et al., 2016; Behn et al., 2016).

– macro-financial variables: developments in other macro-financial variables such as real economic activity, equity prices, inflation and interest rates have also been found to influence the probability of banking sector distress (see Davis and Karim, 2008; Babecký et al., 2014; Detken et al., 2014; Anundsen et al., 2016; Behn et al., 2016.). Interest rates and real economic developments further interact with credit and asset price developments, affecting market participants' risk-taking behavior as well as borrowers' debt servicing capacity.

Few papers have tested the relevance of real estate and mortgage markets' structural characteristics for financial stability. In ESRB (2015) the authors, through both a graphical and an econometric analysis, highlight the role of features such as high LTV ratios, a favorable tax treatment of housing, and high levels of bank leverage as positively affecting the vulnerability of countries to real estate-related distress events. High share of new loans granted at a variable rate, instead, decreases the probability of upcoming distress events. This last result looks somewhat counter-intuitive, since floating mortgage loan rates are usually thought to amplify the link between property prices and interest rates and therefore exacerbate the pro-cyclicality of the real estate market. However, the effect of the share of variable rate loans crucially depends on the evolution of market interest rates. If, during a bust phase, monetary policy tries to offset the economic slowdown by lowering interest rates, variable rate loans might actually dampen the pro-cyclicality of the real estate market.

The role of structural market features in shaping the real estate cycle is not easy to assess. First, because they can have either a direct or indirect effect on other structural and cyclical variables. For example, the tax deductibility of mortgage interest affects the incentives for mortgage financing and thereby households' debt service ratio, which in turn is likely to influence PDs and the losses incurred by banks; in this case the debt service ratio has a direct effect on financial stability, while tax deductibility has an indirect effect. Second, because their amplifying/mitigating role appears in different phases of the cycle.

Most importantly, the assessment of the ability of structural real estate and mortgage market features to provide early warnings against the build-up of systemic risks has been hampered by the absence of reliable and harmonized time series. Currently, harmonized time series on lending standard indicators are mostly not available. Against this background, ESRB Recommendation 2016/14 provides the basis for closing real estate existing gaps in the availability and comparability of data in the EU relevant for macroprudential purposes, by proposing target working definitions of residential real estate (RRE) and commercial real estate (CRE), a common set of indicators that national macroprudential authorities are recommended to monitor along with target definitions of these indicators.

2. Main modeling and evaluation techniques

2.1. The non-parametric signaling approach

The non-parametric signaling approach can be implemented in a univariate or multivariate setting. In the univariate setting, a warning signal is issued as soon as a single potential early warning indicator breaches its predefined threshold, while in the multivariate setting several indicators are considered jointly and a signal is issued when one or more indicators breach their respective thresholds. As the multivariate setting faces dimensionality problems, in Ferrari et al. (2015) only the bi-variate and tri-variate case have been considered.

Following the seminal contribution of Kaminsky and Reinhart (1999), the predictive power of potential early warning indicators is usually evaluated on the basis of the likelihood that the indicator considered is able to correctly predict upcoming crisis events, while at the same time not issuing too many false alarms.

On the basis of the so-called "Confusion Matrix"[7], two key ratios can be calculated: (i) the type I error rate, which represents the fraction of missed crises; (ii) the type II error rate, which represents the fraction of false alarms (i.e., signals wrongly issued). From these values, the predictive power of an indicator can be assessed through different metrics, such as the "noise-to-signal" ratio, the policymaker's loss function and the relative usefulness[8]. These metrics are all calculated for a given threshold, above which the indicator issues a signal. The optimal threshold is then identified as the one that minimizes an objective function, such as the policymaker's loss function (which for a given indicator is equivalent

[7] The "Confusion Matrix" classifies the four possible outcomes in a signaling framework. After a signal has been issued (i.e., an indicator breaching a threshold), it is classified as correct if a crisis follows within the relevant time horizon; if a crisis does not follow, then the signal results in a false alarm. A non-issued signal (i.e., an indicator not breaching a threshold) is correct when a crisis does not follow and it is incorrect when a crisis does occur.

[8] The relative usefulness of an indicator expresses the policymaker's gain from using the indicator for predicting crises compared to disregarding the indicator and always issuing a signal or never issuing a signal. For both the loss function and the relative usefulness, an important parameter is θ which represents the policymaker's relative preference for missing crises (Type I error) versus issuing false alarms (Type II error). See Ferrari et al (2015).

to maximizing the relative usefulness)[9]. Optimal threshold identification always involves a trade-off between missing crises (Type I error) and issuing false alarms (Type II error): a lower (higher) threshold decreases (increases) the probability of missing a crisis (Type I error rate) but at the same time increases (decreases) the probability of issuing a false alarm (Type II error rate).

A further evaluation metric used in recent early warning applications (for example Drehmann and Juselius, 2014) is called AUROC (Area Under the Receiver Operating Characteristic)[10]. The AUROC is a robust evaluation criterion, as it assesses predictive ability for all possible thresholds. Therefore, it does not rely on favorable values of the evaluation metrics for one specific, potentially very narrow, threshold range.

The Confusion Matrix and the associated evaluation metrics require a predefined evaluation horizon. The prediction horizon needs to be chosen long enough before potential crises to allow sufficient time for the policymaker to take preventive action. On the other hand, the evaluation horizon should not be too long either, as this may blur the indicators' signaling power. A prediction horizon of five to twelve quarters is generally accepted in the literature for this kind of analysis. The objective of an EWM is not to predict the exact timing of the vulnerability, but to predict whether the vulnerability will occur within a specific time horizon. Observations included in windows of five to twelve quarters before the vulnerability occurs determine the sample on which Type I errors are computed. Observations outside these windows serve as a basis for the calculation of Type II errors and the fraction of periods where signals were not correctly issued[11].

The results of the multivariate non-parametric signaling analysis in Ferrari et al. (2015) show that more complex models outperform simpler models. Although monitoring single indicators may provide valuable information on real estate-related vulnerabilities, multivariate models that combine the information of several indicators exhibit a better signaling performance. Combining more variables results in lower Type I errors, as it allows for capturing more factors underlying pre-crisis developments. Furthermore, more indicators give an additional level

[9] To this end, a grid search is performed. The grid is bounded by the minimum and maximum indicator value in the sample, and possible thresholds are equally spaced between the minimum and the maximum. For each of these possible thresholds in the grid, the indicator's relative usefulness is calculated. The threshold that maximizes relative usefulness is selected as the optimal threshold.

[10] The ROC (Receiver Operating Characteristic) curve plots the indicator true positive rate against the false positive rate for every possible value of the threshold. The area under the ROC curve or AUROC ranges from 0 to 1: a value larger than 0.5 indicates that an indicator issues informative signals, while for a fully informative indicator the AUROC equals 1.

[11] Observations in windows of one to four quarters before a vulnerability state starts and observations during such vulnerability are usually dropped from the sample.

of confirmation that imbalances in the economy are building up and hence the amount of false alarms may be reduced[12]. Overall, this suggests that policymakers should benefit from considering a broad set of information when assessing real estate-related vulnerabilities.

2.2. Logit EWMs: binary and ordered logit models

The discrete choice framework provides an alternative approach for considering potential early warning indicators in a multivariate, parametric setting. In particular, instead of obtaining thresholds for each individual indicator as in the non-parametric approach, the discrete choice approach maps a number of indicators into a single metric i.e., the predicted probability of a real estate-related crisis occurring within the assumed prediction horizon. Imposing more structure on the aggregation process reduces the dimensionality problem faced in the multivariate non-parametric signaling approach; only one optimal threshold is obtained and a signal is issued when the predicted crisis probability exceeds its threshold.

In Ferrari et al. (2015), binary pooled logit models have been estimated based on the ESRB real-estate banking crises dataset. Several "best models" have been identified according to their relative usefulness including structural (bank credit to GDP, household credit to GDP, total credit to GDP, debt service ratio) and cyclical credit indicators (real total credit growth, real bank credit growth, real NFC and real household credit growth), structural real estate price indicators (nominal RRE price to income gap and price to rent gap), a macroeconomic indicator (inflation) and a market indicator (three-month money market rate).

An important issue that arises with pooled logit models is how to account for cross-country heterogeneity. Given that financial cycles and real estate markets are likely to be heterogeneous across countries, a "one-size fits all" approach might not be appropriate for individual countries. Although the country-level evaluation of the best models performed by Ferrari et al. (2015) show that overall both the non-parametric and the discrete choice methodologies lead to models with relatively good signaling performance for most individual countries, the analysis also reveals a degree of cross-country heterogeneity in the country-level performance of the best logit model on the basis of a pooled threshold.

Country-specific thresholds are therefore an important area for future research on improving early warning signaling performance. One intermediate solution

[12] This is also confirmed by the results of the univariate, bivariate and trivariate logit models in Ferrari et al. (2015).

could be to group countries according to their fundamental characteristics and run the estimation of the logit model by group of countries. A preliminary clustering of the EU countries based on their structural features has been performed by the European Systemic Risk Board (see ESRB, 2015) and five clusters have emerged with few countries in two of them. Estimate a logit model on a subgroup of the EU countries might therefore be difficult because of the scarcity of real-estate related banking crisis events within a cluster.

Ferrari and Pirovano (2016) develop a methodology to compute country-specific and state dependent thresholds for early-warning indicators of banking crises. Using panel data on a number of potential early-warning indicators for banking crises for the fourteen EU countries, their results show that the benefits of the conditional moments approach with country specificities and state dependencies can be substantial. In particular, compared to traditional common thresholds, this methodology provides more robust signals and improves the early-warning performance at the country-specific level, by accounting for country idiosyncrasies and state dependencies, which play an important role in national authorities' macroprudential surveillance.

At the national level, Ciocchetta et al. (2016) have estimated binary logit models for Italy by defining the crisis event as the case in which the vulnerability indicator is above the median value of its historical time series. Nevertheless, in order to overcome the classic binary assumption (crisis vs. non crisis) and to explicitly analyze different degrees of vulnerability the authors have contributed to the recent literature on EWMs by implementing ordered logit models with a discrete number of vulnerability classes. In particular four classes of vulnerability have been defined according to the quartiles of the vulnerability indicator distribution.

However, for the ordered logit regression models it is not so straightforward to calculate the optimal thresholds. The confusion matrix and the associated evaluation metrics presented in the previous section are based on a problem with two classes (crisis vs. non-crisis), while in the ordered logit there are more than two classes. A solution elaborated by Ciocchetta et al. (2016) is to consider weighted metrics that allow to extend the definition of type I and II errors, the loss function and the relative usefulness to the n-class problem. In particular, the misclassification errors have been weighted in terms of the distance between the true class and the predicted one. In the case of four classes of vulnerability this results in penalizing a small prediction error of one class by 1/3, a medium error of two classes by 2/3 and a big error of three classes by 1. Finally, since n-1 optimal thresholds (in particular 3 optimal thresholds) should be defined, the authors have implemented a three-dimension grid search algorithm in order to identify the possible triplets of thresholds and the optimal ones are obtained by maximizing their weighted relative usefulness.

2.3. Linear regression models through Bayesian Model Averaging

In order to define different levels of vulnerability within logit models, Ciocchetta et al. (2016) have discretized the continuous vulnerability indicator; not all the information set has been considered. In order to fully exploit the continuous left-hand side indicator, the authors have therefore also implemented a Bayesian Model Averaging (BMA) based on linear regression models.

BMA is a widely-used technique that has the advantage to be used both for the selection of the most relevant variables and model estimation. It also takes into account model uncertainty by considering combinations of models and thus has the benefit of minimizing subjective judgment in determining the optimal set of early warning indicators.

In particular, BMA tackles the problem of model and variable selection by estimating models for all possible combinations of variables and constructing a weighted average over all the models. If there are K potential variables, 2^K variable combinations are available and therefore 2^K models are estimated. The models are then weighted by their posterior model probability.

By using the BMA, it is also possible to associate each variable with a posterior inclusion probability i.e., the sum of posterior model probabilities for all the models where a variable was included. Therefore, it is possible to get a ranking of the indicators in terms of their importance in the BMA estimation.

To select the best early warning indicators, Ciocchetta et al. (2016) estimated the BMA linear regression model on the training period (1990Q1-2005Q4) and kept the subset of variables that minimize the average prediction error, expressed as root mean squared error, for the test period (2007Q1-2014Q2). In particular, the authors are interested in forecasting the vulnerability indicator one year after the end of the training period for four quarters in order to give time to the macroprudential authority and to banks for activating and implementing any macroprudential tool. A quasi-real-time recursive exercise is therefore performed in order to evaluate the forecasting power of the model on the test period. This results in a new estimation every four quarters using only information available up to that point in time (i.e., the training period is extended by four quarters at each estimation) and enables the authors to test whether the use of the model would have allowed the prediction of potential vulnerabilities.

The authors find that, in Italy, banking vulnerabilities related to households are not only captured by the value added of construction and the number of house sales, but also by indicators of household indebtedness and house price developments. The first two indicators are also relevant for identifying banking vulnerabilities related to construction and real estate firms, in addition to long-term interest rates, the price to income ratio and the growth of credit granted to construction and real estate firms. Roughly the same set of variables is also selected in the ordered logit models.

3. Forecasting exercise

Logit models provide a useful tool to identify early warning indicators; however they suffer from a major drawback. The limited number of crisis observations implies that only in-sample forecasting analyses can be made. For example, using ordered logit regressions, Ciocchetta et al. (2016) were able to forecast the level of vulnerability several quarters ahead (depending on the lags of the early warning indicators). Then, by confronting the systemic banking vulnerability indicator with the levels of vulnerability anticipated by the best ordered logit model, the authors verified the good in-sample predictive ability of the ordered logit model.

BMA on linear regression models instead allow to perform an out-of-sample evaluation of the best model and a true forecasting exercise. In Ciocchetta et al. (2016) the authors, once identified the best set of early warning indicators, have estimated the BMA linear regression model on the training period using the optimal subset of variables and then applied the recursive approach to evaluate the out-of-sample performance of the model on the test period. Finally, the authors have also used the best BMA model, estimated on the whole observed period (1990 Q1-2014Q2), to forecast the average value, together with the first and third quartile of the distribution, of the vulnerability indicator one year after the end of the observed period for four quarters (2015Q3-2016Q2).

Conclusions

Early warning models are an extremely useful tool for macroprudential policymakers in the risk assessment framework of the real estate market, since they are primarily concerned with identifying vulnerable states prior to financial crises. They are therefore to be considered as complementary to the structural models. Indeed, as pointed out by Shmueli (2010), a clear distinction has to be made between explanatory modeling and predictive modeling. While structural models are suitable for assessing how exogenous drivers, such as an increase in interest rates or disposable income, can be transmitted to house prices and loans to firms and households (and therefore if there are imbalances in the housing market), the focus of EWMs is to anticipate potential vulnerabilities for the financial system related to the real estate sector.

As highlighted in this article, early warning modeling is a very complex task with several issues to address, starting with the very definition of a real-estate related banking crisis and the availability of cyclical and structural potential early warning indicators. Depending on the type of the dependent variable (binary, ordered or continuous) the modeling and evaluation techniques differ, along with the prediction capabilities.

Finally, important areas for future research aimed at improving the early warning signaling performance are the development of methodologies for obtaining country-specific thresholds in pooled logit models and the assessment of the role of cyclical and structural variables. Indeed, while structural market features may indirectly influence cyclical developments in the build-up phase, they are likely to directly influence the depth of the crisis. Imbalances and structural developments prevailing during the upturn phase are more likely to influence the resilience to a negative shock, rather than influencing the likelihood of that shock occurring. Further research is needed to analyze more closely the depth of real estate-related banking crises, as well as the role of cyclical and structural characteristics in shaping them.

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Chapter 6

Establishing a framework for financial stability risk assessments in the real estate sector

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Introduction

The real estate sector presents an important transmission of risks to an economy. Dwindling house prices unleash direct effects via lower demand for home prices which further depresses house prices under a vicious circle of house price and demand declines. Indirect effects of the real estate sector onto the real economy impact other sectors of the economy through connectedness channels. For instance, lower house prices undermine households' purchasing power via reduced wealth effects gnawing at the future economic growth. However, currently there is no established framework on how to assess financial stability risks with respect to the real estate sector. We propose a framework which addresses such an urgent need bearing in mind that the Great Recession of 2007–2008 had in its genesis bubble in the real estate sector which created fictitious grounds for bank lending. The rest of the paper is organized as follows. Section 2 focuses on the literature review while section 3 lays the foundation for our proposed framework. Finally, section 4 concludes.

1. Literature review

The real estate sector is viewed by policy-makers as one of the core ones among household, corporate, government and banking sectors, crucial to an economy's financial stability. Real estate prices constitute one of the key indicators for the

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development of asset prices. This explains why many central banks give due consideration to real estate prices when deciding about the future direction of interest rates. According to SNB (2012), banks' exposure to real estate has grown so much that it is now deemed as a menace to financial stability in Switzerland. It is consolidated by the fact that according to SBN (2011) real estate assets make up around 43% of household's wealth composition in Switzerland.

Studies have also focused on house prices. Helbling and Terrones (2003) pointed out that house price busts are often related to output declines which are twice as large as equity bubbles. This implies that the real estate sector effects economy to a higher extent than equities. It is pronounced more in the case of developing economies where equity holdings are skewed only to sophisticated investors. Behn et al. (2013) stated that house prices (among other indicators) acted as a key ingredient in forecasting the building up of risk so that it can be employed as an indicator for the release of the countercyclical capital buffer.

Specific types of real estate properties have also been analyzed. Benford and Burrows (2013) argued that commercial property played a key role in the financial crisis in the UK which led to increases in non-performing loans, resulting in distress in the UK banking sector. In a parallel manner, Ellis and Naughtin (2010) pointed out that "commercial property and property development have historically posed a greater direct risk to financial institutions' balance sheets than have housing and mortgage markets."

Mixed evidence is found as to whether regulation of the real estate sector entails low financial stability risks. For instance, IMF (2011) noted that higher government involvement in housing financing coupled with high household leverage tend to amplify house price swings, thus undermining financial stability. On the other hand, Schneider and Wagner (2015) found that well-developed and regulated rental markets, low home ownership ratios and conservative lending standards, all pave the way towards stronger financial stability.

The real estate sector is also linked to other sectors of the economy so that a "detached analysis" of the real estate sector is likely to underestimate the real level of risks for the economy. For instance, in most developed countries, households' wealth consists of two major components, namely housing and equity holdings. Consequently, an increase in the value of equity holdings leads to higher demand for housing, generating a positive relationship between equity prices and housing prices. The underlying rationale is based on wealth effect of higher equity prices which allows households to hold more equities and to be also able to afford more expensive houses. Zhu (2005) stated that " (...) equity price fluctuations tend to be highly correlated with house price fluctuations six quarters later".

The IMF undertakes regular Financial Sector Assessment Programs for different economies in the world. The Encouraged Set of Financial Soundness Indicators proposed by the IMF (2003) incorporates real estate indicators such as real estate prices, the ratios of residential real estate loans and commercial real estate loans to total loans. This signifies the key role played by the real estate sector in the sphere of policy-making worldwide. However, as at date, there is no established framework which can be employed to assess feasible risks to the real estate sector.

The structural aspects of the real estate market play a major role in shaping the depth of downturns in the real estate/property sector. Indeed, in most developed economies, real estate lending makes up more than 50% of the total bank loans. In Singapore, about 80% of the housing stock emanates from public housing with apartments being resold to eligible citizens after a minimum of five years of occupancy. Due to limited supply, house prices have nearly doubled in 2010–2013 since 2003. In Europe, major differences prevail among countries when it comes to interest rate arrangements. For instance, countries such as Denmark, Germany, France and Netherlands tend to cling more to fixed rate loans while Greece undertook a drastic change, scaling up its floating rate mortgage lending from 28% to 96% from the pre- to the post- crisis period, respectively.

2. A framework for financial stability risk assessment in the real estate sector

This paper sets forth a sound framework with respect to financial stability risk assessment in the real estate sector. We argue that policy-makers should cling to an elaborated and sequential approach when it comes to undertaking a full-fledged analysis of the feasible risks affecting real estate sector. Our framework is based on the following key components, namely:

(a) Composition of the real estate sector;
(b) Knowledge of the structure of the economy with respect to the real estate sector;
(c) Causes of instability in the real estate sector;
(d) Metrics for real estate sector analysis;
(e) A network approach to systemic risk analysis in the real estate sector;
(f) Adherence to Tinbergen's rule when it comes to bolstering financial stability in the real estate sector.

Our framework is illustrated in Figure 1 below. Each of the above components is being discussed in the next section.

2.1. Composition of the real estate sector

Figure 2 illustrates the composition of the real estate sector which is primarily split into the owner-occupied and the rental parts, respectively. The real estate sector can further be dichotomized into the residential and commercial real estate sectors. Compared to the commercial real estate sector, the residential real estate sector tends to be less volatile due to the stable household income and the desire for households to possess a home as a form of self-achievement in life. Most importantly, the need to distinguish between the residential and commercial real estate sectors is warranted based on the fact that the main source of rising non-performing loans relates to commercial real estate lending, as evidenced by the banking crisis in Scandinavia and Japan in early 1990s as well as the 1997–98 Asian financial crisis. The significance of commercial real estate lending is also evidenced by a greater proportion of commercial real estate lending relative to residential mortgages to total lending in most countries.

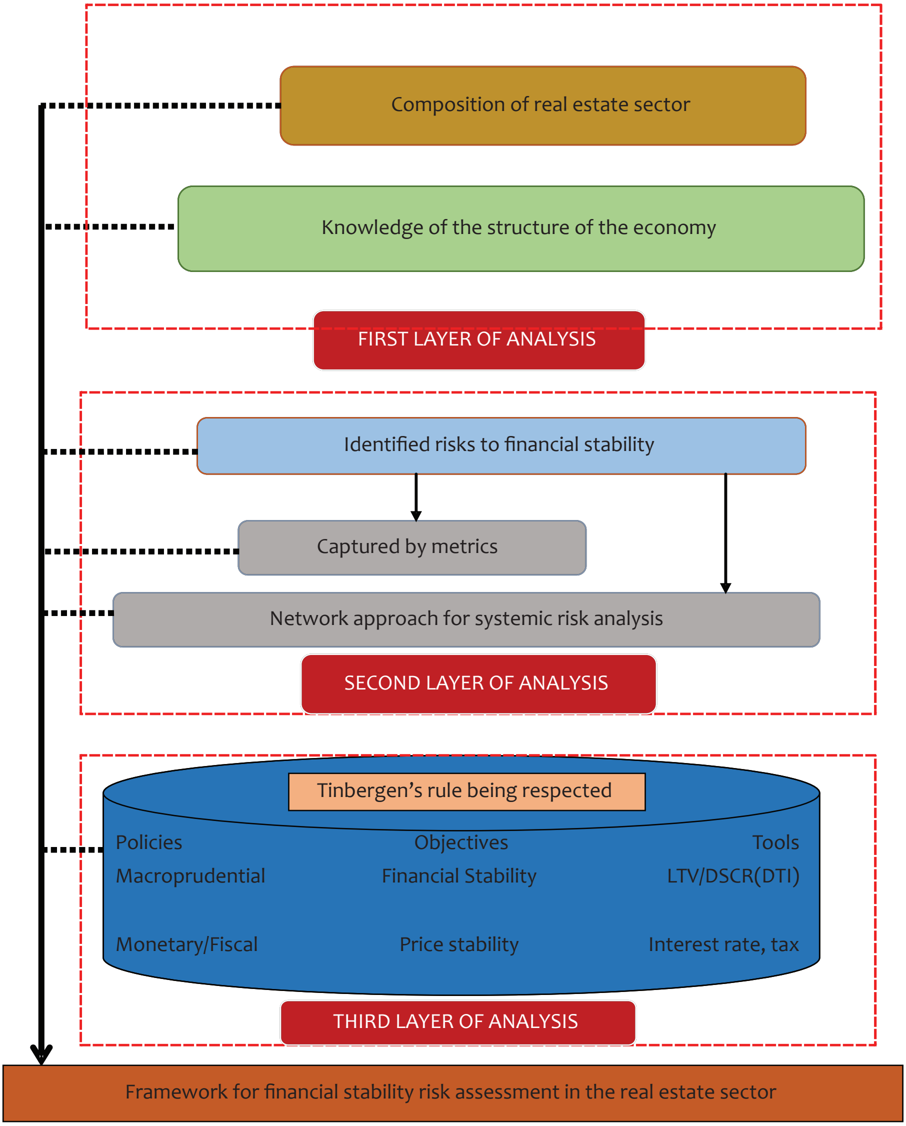
It is of paramount significance to note that commercial real estate loans also include loans to developers of residential real estate. The foreign currency denomination of real estate loans is particularly important for financial stability. In fact, ESRB (2015) stated that the share of loans granted in foreign currency was higher for crisis countries than for non-crisis countries.

Benford and Burrows (2013) argued that commercial property acted as an important catalyst in the UK's financial crisis which increased the number of non-performing loans, trailing behind distress in the UK banking sector. Ellis and Naughtin (2010) reported that "commercial property and property development have historically posed a greater direct risk to financial institutions' balance sheets than have housing and mortgage markets".

The value of commercial real estate is calculated as the net present value of future rental income, discounted by the risk-free interest rate, inclusive of a risk premium rate. Therefore, any increase in rental income will automatically translate into higher values for commercial real estate.

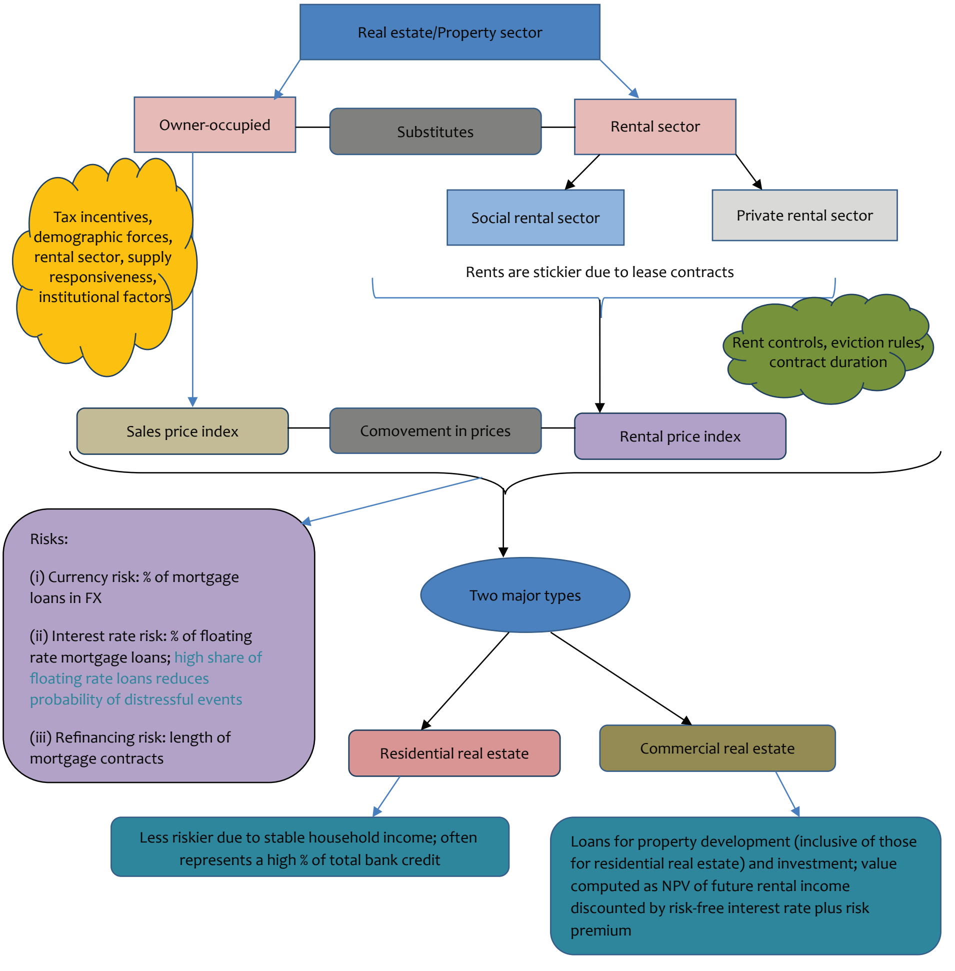
Ownership rates of houses tend to depend on certain factors such as tax incentives, demographic forces, social rental sector, private rental sector, housing supply responsiveness and institutional factors. On the other hand, demand for rental sector depends on rent controls, eviction rules and contract duration.

Figure 1. Framework for financial stability risk assessment in the real estate Sector



Source: own study.

Figure 2. Composition of the real estate sector



Source: own study.

2.2. Knowledge of the structure of the economy with respect to the real estate sector

Knowledge of the economy's structure is particularly important to ensure that proper assessment is being made with respect to the demand and supply forces of real estate market. For instance, in the case of a small economy, a limited supply of land should trigger sustained property prices over time. On the demand side, forces such as demographic factors, disposable income, interest rate, exchange rate, bank credit and market perception of risks, can all impact property price fluctuations.

On the supply side, forces such as land availability, supply responsiveness, financing cost of house, VAT, stamp duties, long-run construction costs and investment decisions can also influence property prices.

House prices are positively influenced by rising disposable income but negatively affected by increasing interest rates and house supply responsiveness. Institutional factors such as taxes also have an effect on house prices. Moreover, house prices depend also on exchange rates in the case of foreign currency contracted housing loans. Currency risk applies mainly to Central and Eastern European markets which have a large share of their mortgage loans denominated in a foreign currency. Claussen (2012) argued that 62% of the hike in Swedish house prices was due to an increase in real disposable income. Some researchers state that a rise in the long-term interest rates makes other fixed income financial assets more lucrative relative to residential property investment and has a bearish impact on house prices. ESRB (2015) stated that "the share of loans granted in foreign currencies was overall higher for crisis countries than for non-crisis countries (…)". Tax deductibility of mortgage interest instantly affects the DSCR (Debt Service Coverage Ratio) of households and their probability of defaults and thereby the level of losses incurred by the banks. Mixed evidence is found as to whether regulation of the real estate sector entails low financial stability risks. For instance, IMF (2011) pointed out that increased government involvement in housing financing associated with high household leverage, tend to boost house price swings, thus weakening financial stability. On the other hand, Schneider and Wagner (2015) stated that well-developed and regulated rental markets, low home ownership ratios and conservative lending standards, all induce stronger financial stability.

2.3. Causes of instability in the real estate sector

The boom-bust nature of property price fluctuations generates business cycles which amplify both the upswings and downswings. Different forces prevail to account for the occurrence of the boom-bust cycles or cyclicality in real estate prices, as discussed by Case and Wachter (2005). These forces consist of:

(a) Construction lags

A rise in Tobin's q (that is, real estate price exceeds its replacement cost) unleashes an incentive to construct more properties. However, due to construction lags, when new properties are built, there may already be an oversupply driving down the prices.

(b) Absence of short selling

In a market with no short sales, prices tend to be dominated by myopic buyers who simply extrapolate price increases into the future despite the lack of fundamentals. The probability of a downturn in real estate prices is usually underestimated in economies which are characterized by sustained price increases over long periods. Such a state of affairs is best encapsulated under the term "disaster myopia" – tendency to underestimate the probability of low-frequency shocks. Thus, property prices tend to be tilted towards the upside rather than on the downside.

(c) Amplifying role played by banks

Herring and Wachter (1999) argued that higher real estate prices encouraged banks to lend more because rising prices increase the economic value of banks' capital to the extent that the banks themselves own the real estate. Banking funding, boom-bust in economic cycles and real estate bubbles are inherently being related to the driving force behind financial instability. For instance, drastic falls in property prices undermine bank's profitability on the back of burgeoning non-performing loans engendering risks to financial stability.

(d) Moral hazard

Salaries and bonuses of bank managers are usually related to achieved profits underprice risks. Therefore, they intentionally undertake higher risks to maximize their own utility functions.

(e) Not enough data to analyze real estate prices

Lack of data implies scarce analyses of real estate market. It is also difficult to use prices of comparable properties for appraisal purposes. It would be apt to have a global database on different types of properties worldwide.

(f) Lack of transparent prices and liquidity

There tends to be lack of transparency in market prices as most property transactions are conducted in the back of bilateral negotiations. In the same vein, market liquidity is being buffeted by high transaction costs with strong reliance on external funding. Besides, the price information conveyed by the property sector is often limited due to low turnover rate of properties, let alone difficulty in finding properties which share almost similar attributes.

(g) Sticky rent contracts

This manifests on the back of long-term rental contracts. The rental price of properties also acts as an anchor for the sales prices of properties as both tend to co-move in the long-run.

(h) Speculative nature of real estate products

Real estate financing poses one of a biggest risks for banks because uncertainty is involved based on speculative nature of real estate products in the world.

(i) Impotency of monetary policy

Monetary policy may be ineffective in dealing with real estate bubbles. For instance, Sornette and Woodard (2010) pointed out that "the fact that the monetary policy of the Swiss National Bank is anchored to the international and in particular the European milieu only makes it harder to exert contra-cyclical pressure on real estate market by interest rate policy". As a matter of fact, as per Tinbergen's rule, if monetary policy is targeted to one specific objective, then, another policy instrument should be used to target the real estate sector.

(j) High LTV and market-sensitive valuation approaches

Borio et al. (2001) argued that two main factors account for the existence of boom-bust cycle in property prices, namely, high LTV and more market-sensitive valuation methods. Consequently, booms in credit supply manifest when real estate prices scale up while credit crunch occurs when real estate prices dwindle. In essence, while market forces tend to elicit booms, regulatory controls trigger busts.

2.4. Metrics for real estate sector analysis

Case and Wachter (2005) underscore the need to develop reliable, timely and consistent statistics on real estate prices to ensure sound macroeconomic stability. Indicators are of paramount significance as they assist in sieving out any feasible risks in the real estate sector so that proactive policy measures can be initiated to avert the building-up of systemic risk to the whole structure of the economy. These indicators are relevant to policy-makers for timely activation of macroprudential instruments.

ESRB (2015) unleashes a comprehensive set of real estate indicators as early warning signals of a real estate-related banking crisis. As a matter of fact, it can be argued that both the length (duration) and the depth (degree of severity) of a real estate-related crisis can be assessed by simply looking at some important indicators. Other indicators are being added to generate a full-fledged analysis of various ratios pertaining to the real estate sector such as ratios related to the housing sector. Property price increases are widely watched as heralds of forthcoming crisis. For instance, Benford and Burrows (2013) pointed out that "Investors and lenders may extrapolate past gains in property prices when making investment and lending decisions, supporting unsustainable price increases".

a) Real estate activity

To generate a holistic assessment of the general level of activities in the real estate sector, authorities can focus on the trend in housing starts, trend in investments in housing and trend in the contribution of housing to GDP.

b) Nominal real estate price gap

This indicator is useful to capture the extent of bullish or bearish force in the current trend with respect to the historical trend. Indeed, the gap is being defined as the deviation from historical trend based on a lambda value of 400,000 for the Hodrick-Prescott filter.

c) Bank credit to real estate sector over GDP

This ratio captures the extent of exposure of the banking sector to the real estate sector. Such an exposure is highly warranted under a network analysis of the real estate sector. Bi-directional causality implications emanate from such a metric. Indeed, if banks are crediting the real estate sector considerably, then, when a crisis manifests and banks deleverage, it will trigger credit crunch to the real estate sector, that is, a decline in the availability of credit to the real estate sector. In the same vein, if bubble conditions prevail in the real estate sector, that will signify spillover risks to the banking sector.

d) Commercial real estate lending to residential mortgage lending

The above ratio is essential to analyze the degree to which bank lending is skewed towards commercial real estate lending relative to residential mortgage lending. The ratio above one, signifies that problems in real estate sector impact heavily commercial real estate with higher effects in the corporate sector. Conversely, if the reverse occurs, then, it implies that problems in real estate impact more the household sector than the corporate sector.

e) Commercial real estate lending to nominal GDP

Benford and Burrows (2013) pointed out that the doubling of the commercial real estate lending relative to nominal GDP acted as a key indicator of a bubble in real estate market in the UK.

f) Real estate prices

Researchers and policy-makers often act as watchdogs when it comes to monitoring real estate prices to disentangle any possible bubbles and risks to financial stability. The International Monetary Fund publishes a Global House Price Index which is based on countries across the world under its Global Housing Watch[2]. To assess the evolution of prices in the real estate sector, the sales price index along with the rental price index can also be used.

The Encouraged Set of Financial Soundness Indicators proposed by the IMF (2003) incorporates real estate indicators such as real estate prices, the ratios of residential real estate loans and commercial real estate loans to total loans. As a matter of fact, financial soundness indicators are widely employed by IMF-World Bank under financial system assessment program. Heath (2005) pointed out that "(…) residential and commercial real estate prices are included in the list of financial soundness indicators along with deposit-takers' lending on such a real estate". These indicators are deemed as early warning indicators because property price shocks manifest with a lag.

g) House price-to-income ratio

The chief objective behind the house price-to-income ratio is to assess housing affordability. The IMF provides information on house price-to-income ratio for

[2] Website link: http://www.imf.org/external/research/housing/

countries across the world under its Global Housing Watch. Such an indicator is highly procyclical being significantly higher in the running up of a crisis to fall after the crisis.

h) House price-to-rent ratio

The house price-to-rent ratio is also found under the IMF Global Housing Watch. It serves a similar purpose as the house price-to-income ratio but here for rental in lieu of owner-occupied properties. The indicator provides useful information as a measure to capture the relative cost of buying a real estate property versus the cost of renting it. The usefulness of the indicator lies in the degree of having an efficient rental market since the indicator is not reliable in the case of an inefficient rental market. The house price-to-rent ratio is anticipated to be very high in the running up phase of a crisis. Such a metric has been underscored by ESRB (2015) which reported that the following ratios not only act as early indicators but also as being able to unleash superior performance relative to other indicators, namely:

– Nominal residential real estate price-to-rent ratio
– Real total credit growth
– Nominal household credit to GDP gap
– Nominal bank credit-to-GDP gap
– Nominal three-month money market rate
– Inflation rate

i) Affordability ratio of home purchases

This ratio is computed as the monthly mortgage repayment divided by the monthly income. A rise in the ratio is synonymous to deterioration in the repayment capacity of the household.

j) Lending standards for real estate lending

This metric tends to be more of a qualitative assessment of the lending standards. Nonetheless, it can be quantified if ratings are to be used to generate a robust standard.

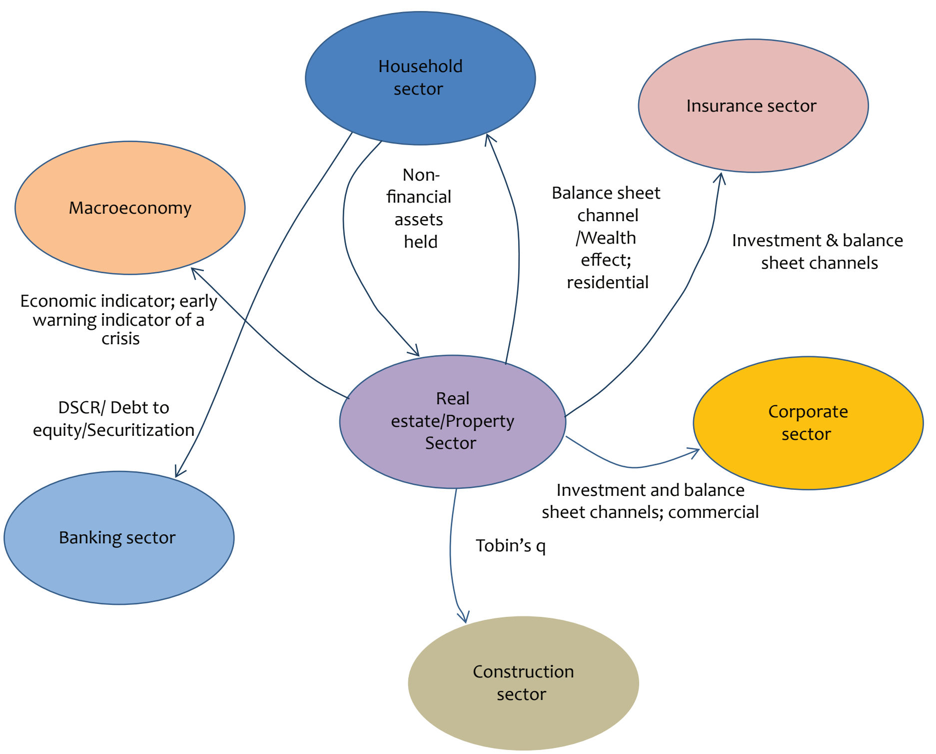
It is widely acknowledged among policy-makers that the following indicators act as early warning system models in terms of financial stability indicators for the real estate sector:

(a) Real estate prices;
(b) Rental prices for residential and non-residential premises;
(c) Bank credit given to real estate sector against GDP;

2.5. Network approach to systemic risk analysis in the real estate sector

We can build a network model for the real sector to gauge on its systemic risk. This is demonstrated in the figure below.

Figure 3. Systemic risk analysis in real estate sector



Tools: Real estate indicators, VAR (GDP, Bank credit, property prices, equity prices and interest rates)

Policies: Monetary Policy (funding costs of banks; exchange rate regime affects MP), Fiscal Policy, Macroprudential measures (first line of defence), Cerutti et al. (2015) advocated the use of a mixture of policies to tackle real estate boom

Source: own study.

(A) Banking sector

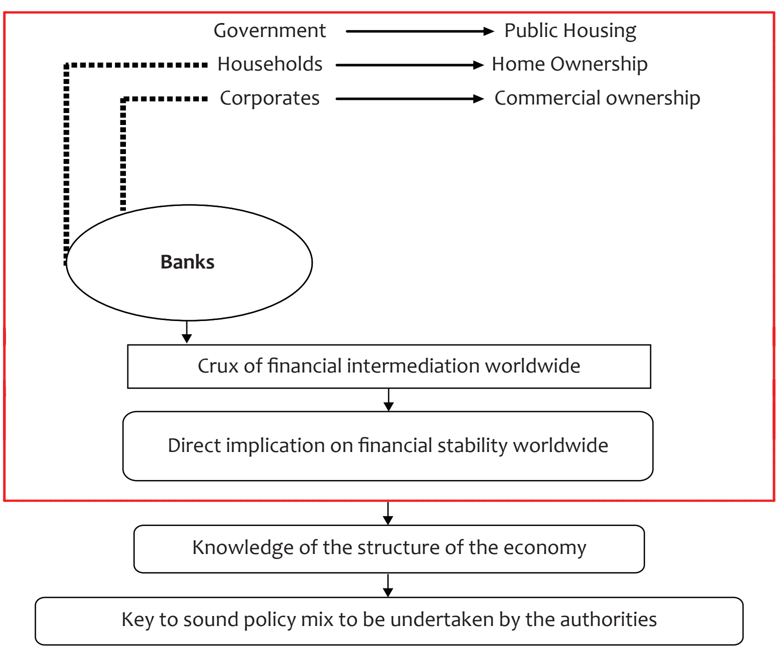
In most advanced economies, real estate lending accounts for more than half of the total bank loans. Exposure to commercial real estate constitutes the main source of loan losses during banking sector difficulties. As a matter of fact, non-performing loans in the commercial property sector are the main cause of a number of banking crises such as in the case of the 1997 East Asian crisis. Increase in real estate prices leads to higher values of collaterals which allows higher bank credit. Fall in property prices leads to deterioration in asset quality, thus leading to lower profitability of banks. In a nutshell, fluctuations in commercial real estate prices impact dramatically loan performance via collateral-induced balance sheet effects spreading to different financial institutions.

The banking sector is automatically related to the real estate market by virtue of the fact that bank funding constitutes the chief source of real estate funding. In that respect, the procyclicality of the bank lending criteria unleashes a robust impact on the real estate market. Most importantly, bank lending standards entail strong repercussions on real estate market. For instance, real estate market bubble in Switzerland during the 1980s was fueled by a decline in mortgage lending standards. The size of the impact of property price shocks on the banking sector hinges on the extent of the bank's exposure to real estate. To contain the adverse effects of property price shocks on the banking sector, the latter should be imbued with ample cushioning cover such as limits to exposure to the property sector, along with high levels of capital ratios to absorb any eventual adverse shocks without jeopardizing the stability of the financial system. Broader capital-based tools, such as countercyclical capital buffer and systemic risk buffer, can also be used to contain risks, as embodied in Basel III.

In practice, it is not easy to disentangle the effect of the banking sector on the real estate sector and vice versa as robust feedback effects permeate into the banking sector – real estate sector interactions. Such strong feedback effects, also known as endogenous effects, are encapsulated under the financial accelerator term – higher property prices lead to higher bank credit which eventually feeds into higher property prices and the process goes on reinforced by the property price – bank credit relationship. Alternatively stated, financial accelerator can be described as leverage which generates a feedback loop between bank credit growth and property asset price increases. The overall process can be stated as follows. Basically, higher property prices consolidate the values of the collaterals furnished for loans so that they increase net worth of both households and companies under improved balance sheet effects allowing them to contract more loans. Based on higher collateral values, banks are also inclined to lend more since margin cover is being enhanced. Such a state of affairs was prevalent prior to the outbreak of the US subprime crisis whereby both borrowers and banks were willing to borrow and lend more based on burgeoning house prices. Amplifying effects on the financial accelerator are generated when property collaterals are being used for non-property loans. For instance, in the event of considerable increase in the value of property collaterals, the latter are being used to provide consumer and corporate loans. And, when excessive bank credit is being granted, it causes property prices to deviate from their long-term fundamentals and triggers off bubbles. The latter get pricked once property prices start falling and banks have to deal with negative equity loans[3] – loans in which the outstanding loan amount exceeds the market value of the mortgaged/encumbered property.

The higher the bank leverage, the higher the probability of a real estate-related banking crisis i.e., the bank leverage acting as an amplifying effect. Above all, during crisis conditions, deleveraging by banks accentuates the downward trend in economic activities.

Figure 4. Real sector analysis from banking sector perspective



Source: own study.

[3] Negative equity loans as well as positive equity loans prevail in the markets.

It is of paramount significance to note that in the case of dwindling property prices, a high loan to value ratio is no more helpful to maintain financial stability, herein comes the need to have recourse to alternative policies.

(B) Macroeconomy and the construction sector

Property prices act as indicators of the general economic activity. Indeed, higher property prices are associated with positive effects on real GDP. In a parallel manner, Helbling and Terrones (2003) argued that house price busts entail output losses. Moreover, rising property prices, as one of the components of Consumer Price Index generate higher inflation. To gain deeper insight of the effects of real estate price increases on output, it is wise to focus on each component of aggregate demand in an economy.

$$AD = C + I + G + (X - M)$$

C: Higher property prices lead to positive equity real estate loans which trigger mortgage equity withdrawal to fund more consumer loans. Besides, higher property prices imply stronger balance sheet positions of both households and companies inducing positive wealth effects which incite higher consumption.
I: Higher property prices trigger higher Tobin's *q* values, well above 1, inducing more investments. As a matter of fact, higher Tobin's *q* values signify that the market value of real estate exceeds the costs for the replacement of the real estate. This is related to the construction sector.
G: Higher property prices imply that government gains in terms of higher land sales and stamp duties enabling higher level of government expenditures in the economy.
(X – M): Higher property prices lead to more expensive rentals increasing the costs of production of local goods which become more expensive relative to foreign goods potentially causing adverse effects in exports. Higher wealth effects connected with rising property prices may also encourage more imports. Thus, a drag down on the trade balance is anticipated to prevail following higher property prices.

Overall, rising property prices are expected to generate strong positive effects on aggregate demand through increased consumption, investment and government expenditures.

(C) Insurance sector

The real estate market influences the insurance sector via investment channel. More specifically, commercial property constitutes a key investment class for many investors such as insurance companies and pension funds, let alone sovereign welfare funds. Such investment channel triggers balance sheet effects such as higher property values leading to higher investment values and larger equity base inducing more investments.

(D) Corporate sector

The real estate sector also impacts corporate sector via investment channel when companies hold Real Estate Investment Trusts. Therefore, balance sheet effects also prevail.

(E) Household sector

Households hold both financial (cash, deposits, securities (equities, bonds)) and non-financial assets (property). In practice, there can be a robust co-movement between the owned financial and non-financial assets mailnly in developed economies where households hold an important chunk of equity. For instance, higher equity prices translate into more household wealth and induce higher demand for houses. The household sector is thus automatically linked to the real estate sector through robust balance sheet/wealth effects. ESRB states (2015) that mortgage loans to GDP amounted to around 45% in Europe at the end of 2013, clearly depicting the significance of the household sector in Europe when it comes to financial stability assessment.

Overall, the links between the household sector and the real estate sector can be stated as follows:

(a) Higher real estate prices increase the wealth level of households who posses real estate under balance sheet effects driving up the level of consumption, positively impacting GDP. In most advanced economies, the main assets held by households comprise of equities and houses. Compared to developing countries where only wealthy households can invest in properties via direct purchases of houses, in advanced economies, both moderately well-off and rich households participate in the property market not only via direct house purchases but also via investments in property funds such as REITs. In the case of contracted loans, the positive effect on consumption emanates from households who are able to extract consumption from house wealth via mortgage equity withdrawal. Most importantly, loans which are secured by properties as collaterals extend beyond real estate loans encapsulating other loan types such as consumer loans, personal loans and business loans, all leading to pronounced balance sheet effects.

(b) Since real estate is very expensive, households use bank loans to finance their purchases. Thus, the banking sector connects household sector with real estate sector through mortgage debt usually constituting the main liability component of the households. It produces an important implication, namely, household leverage amplifies any downturn effects during crisis conditions.

2.5. Policies to bolster financial stability in the real estate sector

Financial stability assessment requires a sound and critical analysis of the real estate market. Helbling and Terrones (2003) pointed out that house price busts are often related to output declines which are twice as large as equity bubbles. Moreover, to formulate sound monetary policy in order to consolidate financial stability, it is imperative to have proper knowledge about the source and nature of real estate price fluctuations.

(a) Monetary policy

Monetary policy impacts either the cost of credit or the money supply. Thus, any change in the monetary policy will undeniably impact the cost of acquiring funds by the banks affecting real estate market. As a matter of fact, asset price bubbles are usually considered to be best pricked by a contractionary monetary policy. This implies that a hike in interest rates makes borrowing more difficult and reduces credit action which eventually translates into lower demand for real estate and drives down their prices. However, the effectiveness of monetary policy depends on the reaction time to an imminent bubble in the real estate sector. Above all, the exchange rate regime will exert substantial impact on the effectiveness of monetary policy. For instance, in Hong Kong, monetary policy is ineffective in containing financial stability risks on the back of adherence to a currency board. Monetary policy is more effective when floating rate mortgages are prevalent. Ramlall (2015) argued that free banking and dollarization also buffet the effectiveness of the monetary policy transmission mechanism.

After the US subprime crisis, the widely used Taylor rule which captures changes in interest rates as a function of inflation gap (potential inflation versus actual inflation) and output gap, has been adjusted to factor in asset price gaps to avert possible bubbles. In a nutshell, monetary policy is deemed as a response tool to asset prices. However, the hitch related to adjusting the Taylor rule to accommodate for asset price gaps is based on the notion that one policy instrument cannot fulfill two objectives.

Based on the concept of Tinbergen's rule (1952), monetary policy has been criticized heavily by policy-makers because two independent policy instruments are required in order to attain the twin objectives of price stability and financial stability. Such a debate led to emergence of macroprudential tools to back financial stability while monetary policy should maintain price stability. This approach is supported by the growing number of policy-makers.

(b) Fiscal policies

A fall in the tax rates results in higher income of households which can afford new houses, thus leading to house price increases. Conversely, a hike in the tax rates scales down the demand for housing. Kutter and Shim (2013) found that, besides LTV and DSTI ratios, tax treatment of housing substantially impacted credit and housing price growth. Proper analysis of the demand for real estate is also required. For instance, if strong demand for apartments is driven chiefly by foreign capital, the government can consider imposing a foreign tax on property purchase to mute down undesired pressures.

(c) Macroprudential measures

These measures include prudential ratios geared towards consolidating the general financial stability of the economy. They consist of measures such as capital ratios, countercyclical capital buffer and systemically important financial institution capital surcharge, as promulgated by Basel III. The chief advent of macroprudential measures is that they fulfill the conditions imposed by the Tinbergen's rule.

(d) Loan to value ratio

The above ratio falls under the purview of macroprudential actions. High LTV ratios are expected to amplify the vulnerability pertaining to a real estate related banking crisis. Low LTV loans lead to low risk weights[4] and then to low capital

[4] For instance, 50% risk weight can be set for mortgages having LTV ratio below 70% while 100% risk weight is being set otherwise. The aim of scaling up risk weight is to curtail growth in lending in that specific sector type.

requirements. An LTV cap can also be employed to mute down credit growth by ensuring absence of any loose credit standards during the building up phase of a crisis. Crowe et al. (2011) noted positive evidence in favor of LTV limits as a macroprudential tool in addressing housing booms. Similarly, Morgan, Regis and Salike (2015) pointed out that LTV limits helped to scale down the build-up of leverage in the housing sector. For proper implementation of LTV, there is the need to not only design LTV but also to calibrate it with the needs of the economy. In a nutshell, LTV assists in restraining credit expansion in a bubble period. LTV limits were introduced in Korea in 2002 while Hong Kong SAR has implemented LTV limits since 1990s. Loan to value ratio does not however generate complete cushion in cases of substantial declines in property prices.

(e) Debt service to income ratio

Coupled with LTV limits, DSTI ratio has also been widely used with Asian economies being the main pioneers in wielding these tools. Korea introduced DSTI in 2005 while Hong Kong SAR had already had it since 1994. After the US financial crisis, many countries emulated similar policies to contain property bubbles.

In essence, LTV and DSTI limits represent important policies which fall under the purview of macroprudential policies to avert property bubbles and their associated adverse effects on the economy.

(f) Development of real estate price indices

Impact of the real estate market on the financial stability requires the development of real estate price indices which help to monitor these markets. For instance, there is the S&P/Case-Shiller U.S. National Home Price Index which is also published by the Federal Reserve Bank of St Louis. Case and Wachter (2005) pointed out four methods to build residential real estate price indices:

Average or median price approach. It uses the median price of residential properties. Median price is deemed to be better than the average price as the latter is imbued with strong sensitivity with respect to the presence of extreme values in the data.

Representative-property method. One should first define a representative property and then record the value of a property in each period based on the pre-defined features of the representative property.

Hedonic price method. It uses an econometric model which captures house values along with their respective characteristics with regression coefficients representing their impact. The main benefit of such an approach is that it reduces subjectivity embedded in the representative-property method. However, the hedonic price method is not free of certain drawbacks such as the need to have extensive data along with sound functional form for the model.

Repeat-sales method. This approach benefits from the fact that the same property may be transacted several times so it becomes interesting to record the values for each transaction and thus there is lesser need to focus on the attributes of the property which are less susceptible to change. Since it only uses values of the transactions, the repeat-sales method requires little data collection. However, it assumes that property features have not changed over time.

(f) Use of long-term real estate values and focus on extreme volatility

To combat the above factors which induce cyclicality in real estate values, Case and Wachter (2005) argued for the use of two tools. First, long-term real estate values in lieu of short-term values should be used to calculate LTV as the former is more stable. Second, extreme volatility in real estate price indices is a warning signal against the existence of possible bubbles.

(g) Loan type

The loan type itself can be a source of protection. For instance, housing loans in which case the borrower expresses strong commitment to repay them as house is a part of his personal wealth, carry lower risk relative to loans for construction of commercial projects.

(h) Countercyclical measures

Countercyclical measures are needed to buffer real estate lending which tends to be procyclical. The aim is to attenuate or mute down the inherent procyclical lending nature of banks.

(i) Deleveraging

Deleveraging mostly manifests after a crisis hits an economy. Deleveraging pertains to the process of scaling down debt, in particular, private one. For instance, banks begin to curtail borrowings and undertake balance sheet restructurings. Both corporate and household debts over GDP are expected to decline in the result.

(j) Real estate sector policy feeding onto itself

Real estate prices have now obtained a prominent role under Basel III application with respect to countercyclical capital buffer. As a matter of fact, Behn et al. (2013) stated that house prices (among other indicators) acted as a key ingredient in forecasting the building up of risk so that it can be employed as an indicator for the release of the countercyclical capital buffer.

(k) Strong vigilance in short-term and increase in land supply in the long-run

The best policy to curb excessive real estate price appreciation is to maintain enough land supply for real estate in order to ensure a healthy development of the real estate sector. Unfortunately, such a strategy can best be accomplished in the long-term horizon. In the short-run, major shocks can unleash real estate price bubbles, so the need for strong vigilance of the regulators.

Conclusions

Financial stability risk management constitutes one of the top priorities in the agenda of any government in the world with the real estate sector being considered crucial to the economy. However, there is currently no framework with respect to how financial stability risks should be managed in the real estate sector. This paper derives from a number of real estate literature in order to propose a framework which incorporates the following key ingredients: composition of the real estate sector, knowledge of the structure of the economy with respect to the real estate sector, causes of instability in the real estate sector, metrics for real estate sector analysis, a network approach to systemic risk analysis in the real estate sector and policies to bolster financial stability in the real estate sector. We strongly believe that following framework would further increase financial stability in the world.

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Chapter 7

Mortgage insurance, its effectiveness and impact on financial stability based on selected crisises – recommendations for Poland

Michał Wydra[1]

Introduction

Mortgage Insurance Programs and the experience of countries that introduced them provide interesting information. Presenting the experience of selected countries, I decided, based on the collected data, to find out whether this financial service has improved the security of the financial system and its effectiveness, that is whether it has reduced credit risk and has increased the availability of housing loans to the public. Until the mid-1990s, mortgage insurance was one of the most dominant insurance products. The relatively important criteria for the universality of mortgage insurance were:

- low interest rates on loans, standardization of banking and insurance procedures, enabling securitization and issuance of securities on the capital market (secondary market),
- access to standardized information about the market, borrower and collateral, and
- small fluctuations in the value of collateral for loans – real estate.

The price for mortgage insurance (the so-called premium for insured risk) was set differently. Different approaches were used:

- the cost was added to the interest rate on the loan,
- fees were charged once at the very beginning of the loan,
- the fee was taken into account in the entire capital of the loan granted,
- fees were collected annually or monthly.

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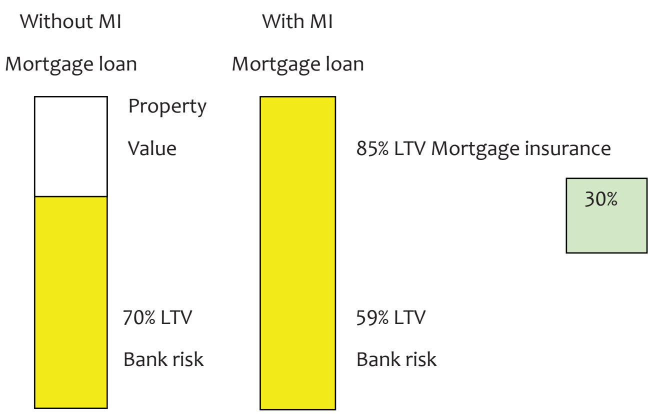
The main factors affecting the premium are the data on the frequency of losses / damages / occurrence calculated on the basis of bank data or (LGD) part of the bank's credit exposure, which if the borrower becomes insolvent (the so-called default – no repayment) will be lost. These data influenced the determination of the level of risk the insurer could cover during the negotiations with the bank.

1. Sample programs and scope of activities in the world

The main assumption of introducing mortgage insurance was to enable people who did not have a high down payment (sometimes amounting to 20–25% of the loan value) to obtain a loan. The implementation of such a product has provided many people with new flats, apartments. In times of very high housing prices, the mortgage market was stimulated. The operation of insurance with a high down payment is illustrated in the figure below.

Figure 1. Mortgage insurance product – how it works?



Source: USAID materials, Urban Institut.

Mortgage insurance was first used in Germany in 1858. This solution was not as popular as in the second half of the twentieth century. It functioned from about 1860 and with different effects lasted until the 1930s. The reason for their small role at that time was a different approach in risk insurance and target groups, which this risk concerned. Table below summarizes mortgage insurance programs in individual countries by providing data such as the number of companies, total capital, written insurance, the number of loan institutions served and the share in the entire market. The following information was obtained from published sources and direct data from mortgage insurance providers.

Table 1. Selected international MI programs

Country	Launch year	Number of MI companies	Own capital	Insurance written	Number of customer	Estimated share of insurance vovered mortgage market
The United States – private MI	1956, 1987	7	16 billion USD	337 billion USD	thousands	13.4%
The United States – govern. MI	1934	2	23 billion USD	187 bil	thousands	7.5% (FHA)
Canada	1954 and 1963	2	1.4 billion USD	42 billion USD	140	ca. 50%
Australia/ New Zeland	1965/ 1994–2004	2	367 million USD	60 billion USD	200	ca. 40%
The United Kingdom	before 1970	n/a	n/a	n/a	n/a/	35%
Republic of South Africa	1989	1	25 million USD	205 million USD	n/a	n.a.
Israel	1998	1	11 million USD	450 million USD	8	11%
Hong Kong	1999	5	n/a	15 billion USD	40+	ca. 15%
The Philippines	1950	1	109 million USD	280 million USD	n/a	n/a
Kazakstan	2004	1	3.3 million USD	n/a	8 to 12 est.	n/a

Source: own study based on FHA, CMHC, APRA, UK FSA, Hofinet, Bank of England, World Bank data.

Some of the above programs were introduced over half a century ago in the US, Philippines and some have only recently been introduced in Hong Kong, Israel. Programs presented above take into account different types of sponsorship by directly the government of a given country, government agencies, non-profit institutions and private initiatives. The information available made it clear that the US has the longest history of mortgage insurance programs and the turnover scale. Various approaches to mitigating the mortgage portfolio risk were developed with the support of mortgage insurance in countries due to their diverse housing needs and financial possibilities. The table below presents the mechanisms of using mortgage insurance in times of boom and credit decline, and product solutions in which they were most often used.

Table 2. MI products in selected countries

	Canada	US	Australia	UK
	Mandatory LTV > 80%	Encouraged, but not mandatory	Not mandatory	Not mandatory
Coverage	Original full loan amount	Partial loan amount	Partial loan amount	Partial loan amount
Amortization	Full amortization period	Partial amortization period	Partial amortization period	Partial amortization period
Mortgage types	Renewable terms	Fixed terms predominate		
Premium payment frequency	One time	Flexible	Flexible	Flexible
Tax deductibility – dremiums	Not available	Available	No	No
Underwriting standards	Conservative	Before crisis, aggressive; after crisis, conservative	Conservative	Before crisis, aggressive; after crisis, conservative
Government guarantee	Explicit and unconditional	Implicit (Fannie, Freddie); explicit (Ginnie)	No	No

Source: own study based on FHA, CMHC, APRA, UK FSA, Hofinet, Bank of England, World Bank data.

Considering the application of these systems, there is no ideal system supporting the housing financing system also in the selection of the subsystem supporting it, which may be the insurance system. A common feature of the analyzed systems was that the model for their implementation was based on the experience of the US economy. In most of the cases discussed, despite the implementation of US model solutions, the functioning of these systems, taking into account local specificities, changed over time. The mortgage insurance system has similar shortcomings. Undoubtedly, its big advantage is a significant risk reduction. Unfortunately, as market practice shows, the obvious principles of prudent risk management involving this subsystem have not always been respected. Thus, such a rapid destruction of the market and lack of trust between participants have lead to deepening of crises and sometimes aversion of many market participants. Clear and legible regulations and an understanding of the functioning of this system in the government's housing policy play a significant role in stabilizing the mortgage insurance system as well as the entire housing financing system. It is a tool / instrument for an effective housing policy.

Analyzing the various systems of financing the real estate market in which mortgage insurance is available, one may put forward a preliminary thesis that these solutions allowed for protection against long-term risks. Often, however, such a cooperation followed crises and disintegration of financial markets. Most of these crises resulted from too much faith in market self-regulation and an unlimited risk appetite on the part of financial institutions, benefiting mainly from this type of instrument and lack of experience and supervision of market regulators. A classic example of this were the US crises (the great depression of 1934, subprime 2007) and and a crisis in England (1990). But there were also cases during which this mechanism worked very well during recession, supporting further development of the market, increasing its resilience to the crisis and indirectly affecting the further development of housing, ensuring a steady stream of loans (in the form of compensation payments and reducing credit risk) e.g., during the recession in the US (1972, 1980 and 1990), Australia (1994), Canada (2007).

Deep recessions and crises in the financial markets are the most important exams for those systems. Taking into account the cyclical nature of the real estate market and the occasional overlapping of various negative phenomena that intensify during recession and crises, these systems had the basic task of collecting premiums in times of good housing conditions, and ensuring its stabilization through payment of compensation in times of destabilization.

An important role in the functioning of mortgage insurance systems was played by the housing, fiscal and supervisory policies and regulations of the State. By default, it set risk level limits, above which credit institutions have to insure themselves in the event of default. A classic example of this are real estate loans above the 80% LTV ratio. In other areas, practices that could destabilize the market and encourage taking greater risks were reduced. For example, they are:

1. no possibility to write off interest on the loan,
2. isolating mortgage insurance business from the insurance company's structures and
3. not combining this activity with other business lines.

In the case of insurance companies, it was ordered to use and create unique reserves in the event of mass compensation payments. The cooperation of banks with insurance companies consists in proper management of the risk insured i.e., its limitation and transfer beyond the real estate market financing system. Hence, the problem is how far and on what scale the risk taken by insurance companies from the banking sector affects their ability to pay compensation and maintain liquidity. The key is an appropriate risk diversification, both product-based, depending on the LTV and geographical index, and constant monitoring of its development based on standardized and verified data.

International experience shows that mortgage insurance was created in order to primarily finance clients with an increased risk profile, which includes loans with LTV above 80%. Under certain conditions, insurance companies take over the risk of such loans, guaranteeing, in return, insurance of its repayment in the event of a definitive cessation of the payment of principal and interest installments. Another benefit of this mechanism is that customers can get a loan more quickly, instead of wasting time to collect the right capital in the form of savings that they would normally have to accumulate for many years. Launching this mechanism on a larger scale meant that the ratio of flats owned by the population increased, contributing indirectly to the growth of wealth, because the additional loans stimulated the economic situation and demand for housing. Another benefit that demonstrated high usefulness and effectiveness of this mechanism was the maintenance of a steady flow of credit to households during a deep recession. In this situation, financial institutions usually tighten the criteria for granting loans, limiting, for example, financing of risky development projects, if they do not have appropriate securities in the form of, for example, fiduciary accounts or insurance guarantees. Having credit insurance increases safety and awareness of the risk taken by financial institutions and is a clear signal for the investor that the investment will be realized without the risk of excessive losses and loss of reputation.

Current experience has shown that the mortgage insurance system in some countries has experienced a serious crisis and the loss of liquidity of some insurance companies. The main reason for this situation was its too strong connection with the capital market, which insured loans from the so-called subprime segment and the accompanying significant loosening of the credit policy, especially supervisory policy.

There are also other experiences where, for example, the market based on the mortgage insurance system stabilizes the economy even if its products and scope cover a significant part of the market e.g. 50% in the case of Canada. Thanks to the strong supervision and elimination of solutions and products threatening its stability it was possible to maintain security on it without the need to involve public funds in financing unprofitable companies or government programs. They also played a special role during the real estate cycles. Insurance companies taught by experience from previous crises simply avoided excessive risk, and either refused to continue insurance or increased fees for its management.

Western experience has shown that insurance allows one to increase the availability and sale of loans. It may contribute to an increase in the level of meeting housing needs and, additionally, stimulate the economic situation in the economy.

2. The impact of financial insurance on the stability of the real estate financing market and the financial system

Foreign experience indicates that the implementation of MI in these markets had a huge impact on the stability of the financial sector, its resistance to a downturn and risk diversification. When describing the role and impact of this non-bank system supporting the banking system, the central bank plays an important role. It has an instrument of interest rates. Usually, the Central Bank, guided by inflation limitation, stabilizes domestic currency, can raise and lower the interest rate encouraging banks that offer loans and accumulate money in the form of deposits, to offer their customers products on more attractive terms. For example, an increase in the interest rate will limit lending (because loans will be too expensive) and will encourage the population and entrepreneurs to invest capital in deposits (because their interest rate will be higher). Conversely, lowering the interest rate will encourage banks to grant loans (because the money offered by the banking sector will be cheaper), and the entrepreneurs and people using them will use it enormously because deposits will not be as attractive as before. In the case of linking banking and insurance sector services, the transmission mechanism of the central bank will impact banks directly and insurance sector indirectly. For example, an interest rate increase will limit banks' lending and insurance services related to loans (e.g., mortgage loans and insurance services, such as low down payment, unemployment insurance, real estate and housing, legal title to real estate and bridge insurance until the mortgage registration in mortgage register). There will be growing interest in long-term money placement services such as deposits and life insurance. In the case of lowering the interest rate along with the development of bank lending, the demand for protection against the occurrence of a specific credit risk will increase.

In the case of the analysis of the financial system stability and its resilience to economic recession and the negative effects of, for example, a fall in prices of housing securing loans, it has been repeatedly observed that a larger share of mortgage insurance stabilized the financial system. Insurance companies adhered to the basic principles of risk management (i.e., they insured measurable risk and did not take more risk to cover than they were able to secure with adequate reserves) and were able to effectively reduce the negative effects of the downturn in the real estate market and housing prices. In many markets, due to their specificity and specific focus on the insured risk, insurance companies were treated as second eyes checking the risk previously taken by the banks. Therefore, in many studies, covering part insurance (usually about 20% of the loan value or total in the case of LTV exceeding 80%) of housing loans, due to their high share in generating GDP (usually between 30–80%), is an important element of the so-called countercyclical policy. More broadly, the LTV ratio may become an important part of the macro-prudential policy of the government and relevant central bodies.

Table 3. Examples of the use of various indicators and limits on the risk of housing loans for the implementation of a countercyclical policy

Housing related measures (MAPPH):	Nonhousing related measures (MAPPNH):
Time-varying loan-to-value (LTV) caps	Countercyclical capital requirements
Time-varying debt-to-income (DTI) caps	Dynamic loan loss provisioning
Other housing measures such as, quantitative limits on mortgage lending, risk weights on housing loans, housing tax, etc.	Credit growth ceilings
	Consumer loan limits

Source: Akinci and Olmstead-Rumsey (2015).

This policy is a consequence of the rapid development of the housing market. It manifests itself in a too rapid increase in household debt. Consequently, this leads to an increased risk of non-repayment of loans, especially when the increase in debt is not offset by a corresponding increase in the income of the population. In the growing phase of the real estate cycle, it may lead to a mass destabilization of repayment of housing loans in the event if one of the elements of the risk of loan defaults. Therefore, the main element of this policy is to set limits on specific risks, in this case a fixed limit on the amount LTV. In the case of mortgage insurance, a limit of e.g., 80% LTV was imposed top-down, the exceeding of which had to result in a compulsory loan insurance or in the absence of rejection of the loan application due to too high risk. This limit was usually based on historical experience indicating that at the level of LTV ratio above 80% the probability of loan default increased significantly. In the western markets, this limit varieddepending on the type of property financed (for investment purposes – rent or ownership) and the amount of the risk taken / insured (100% credit or only 5–20% of the loan value). Foreign experience, especially in the US and the UK, showed that the introduction of a limit on the LTV ratio may curtail the anticyclical phenomenon in the real estate market much better than the increase / decrease in the interest rate by the central bank.

The best example of markets implementing anti-cyclical policies are Canada and Hong Kong. This process takes place on two levels: macro and micro. In the case of the second, for example, the Office of the Superintendent of Financial

Institutions (OSFI) in Canada – the equivalent of the Polish Financial Supervision Authority has sufficient competence to introduce recommendations / a set of rules to be followed by financial institutions granting housing loans. In 2012, OSFI introduced limits for loans from LTV to 95%.

In the case of macro-level activities, specialized insurance companies, such as CMHC (insurer backed by the government) operating on the mortgage housing market, Genworth (a private insurer) analyze the risk of the insured portfolio and the prospect of its growth or decline taking stabilizing measures. These include increasing the margin for the risk of non-repayment of the loan or top-down limiting the risk which is accepted for insurance through the classic LTV ratio. Experiences from both markets have shown that with the appropriate saturation of these insurance products, one can trigger the expected changes within a fairly short period of time. That is, reduce fluctuation in housing prices and indirectly stabilize the unemployment rate (especially in the real estate market), and lower the mortgage portfolio risk. The graphs below show empirically how mortgage insurers stabilized the market during the last subprime crisis (which occours in 2006). In order to prevent the growth of risk in the housing loan portfolio, actions were taken. First, CMHC in Canada gradually tightened the criteria for concluding loan insurance contracts by setting limits on loans from the LTV and the loan period. The actions given are described in the table below.

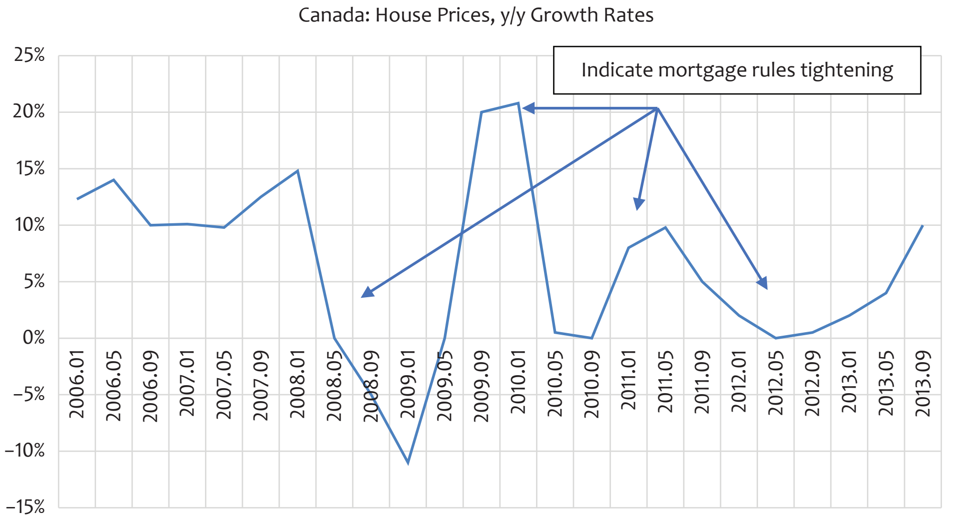
Table 4. Key changes in government-backed mortgage insurance rules: 2008–2012

Round of tightening	No. 1 9 July 2008 15 October 2008	No. 2 16 February 2010 9 April 2010	No. 3 17 January 2011 18 March 2011	No. 4 21 June 2012 9 July 2012
Maximum amortization period	40 to 35 years		35 to 30 years	30 to 25 years
LTV limit for new mortgages	100% to 95%			
LTV limit for mortgage refinancing		95% to 90%	90% to 85%	85% to 80%
LTV limit for investment properties		95% to 80%		

Source: Kuncl (2016).

The actions taken at the micro and macro level have resulted in the following reactions and changes in trends in the real estate financing market. This is best illustrated by the example of housing prices and the growth of the mortgage loan portfolio.

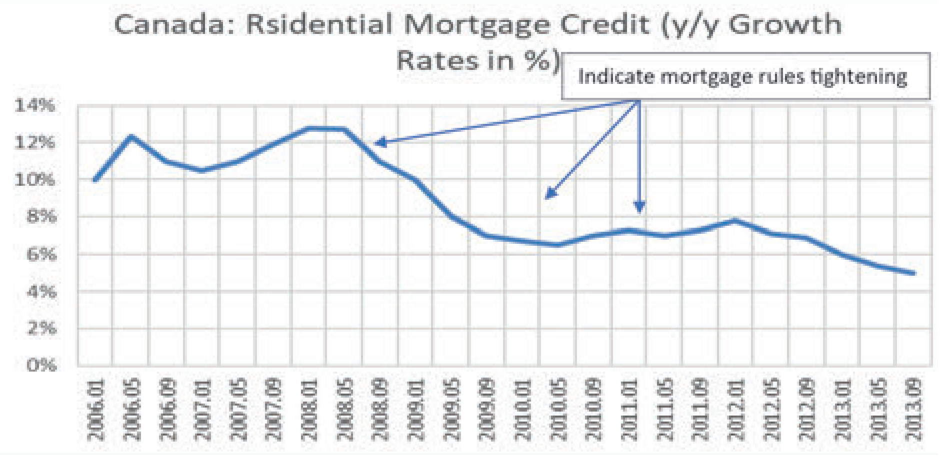
Figure 2. Canada indicator of % increase in home prices year on year



Source: Canadian Real Estate Association.

The introduction of the above mentioned changes in the credit policy accepted for insurance in an appropriate and expected manner was controlled by the amount of housing loans granted as shown in the chart below.

Figure 3. Canada: an annual increase in housing loans



Source: Bank of Canada.

The subprime crisis has become an interesting moment to establish housing mortgage insurance, an important element of prudent macro policy. According to the authors of the report for the Canadian government, "Mortgage Insurance as a Macroprudential Tool: Dealing with the Risk of a Housing Market Crash in Canada (see Institut C.D. HOWE 2015) – three criteria should be met:

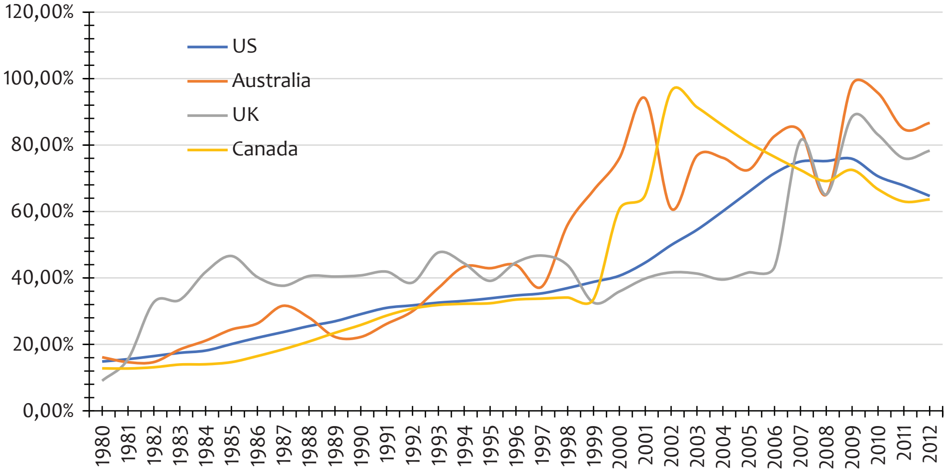
1. all insured housing loans should be granted according to one standard, to avoid the risk of moral hazard among lenders,
2. government support should be maintained, but only in terms of the systemic risk of a rapid collapse in the real estate market. The main reason is the decline in housing prices, which is accompanied by rising unemployment and the growing temptation to ease credit standards among insurers. Maintaining government guarantees provides stability and protects the mortgage insurance system from bankruptcy, because it gives a clear signal to insurers that there is collateral in the event of a loan failure,
3. the ideal mortgage insurance system is a system that prevents major fluctuations in housing prices. This solution can be applied by introducing a corresponding increase in the premium for the insured risk at the time when the risk of fluctuations in housing prices increases. And vice versa, lowering the premiums in case of decreased risk.

3. Impact of mortgage insurance on the effectiveness and stabilization of the mortgage loan insurance market

To assess the ability of the mortgage insurance system as a system ensuring on the one hand the stability of the financial system (understood as resilience to insured risk, stabilization of property prices) and its effectiveness (understood here as reducing credit risk and consequently increasing the availability of credit for a larger population) I have choosen a few selected examples / indicators of countries in the form of calculated ROE, ROA of the banking sector, the ratio of the financing portfolio to GDP and insurance to the financing portfolio. Finally, based on the estimated data, I have investigated what was the risk hedging in the form of provisions created for the insured risk.

The way housing loans influence the development of the economy is pictured by the relation of the portfolio financing these needs and the GDP of selected countries. In some of them, this share exceeds significantly 60% of GDP.

Figure 4: Outstanding value of housing loans in relation to GDP



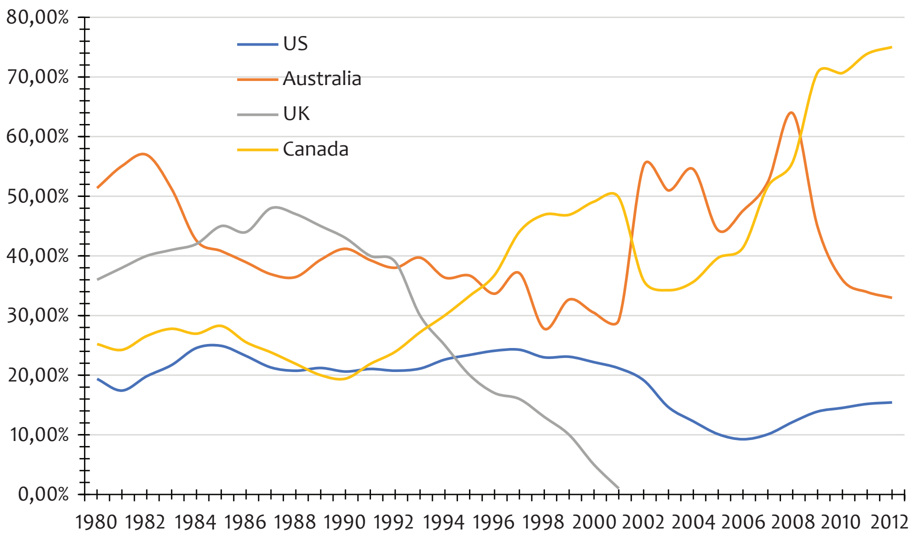
Source: own calculations based on FED, Bank of England data.

The above chart shows that this relationship fluctuates. In these selected countries, the falls in this relationship were the result of a recession or crisis in the real estate market, and sometimes a change in the local government housing policy. The chart below presents a different ratio describing the portfolio of the insured mortgage risk to the level of outstanding value of housing loans. As it is seen, it was also subject to fluctuations and usually this changes were similar to the data from the previous chart, but they were delayed by about 1–2 years. The reason behind, was the trial (different in individual countries) of debt collection / seeking compensation for the insured loan. Usually, the share of insurance in the funding portfolio fluctuated between 20 and 50%. A deviation from this principle to 70% resulted mainly from changes in the definition of a mortgage loan on these markets and ways of implementing housing assistance (data for a large part are estimates in addition to US data).

Among the most interesting indicators showing the effectiveness of used capital in the banking system are ROE (Return on Equity) and ROA (Return on Assets). For the purposes of this analysis, indicators for the entire banking system were used. The real estate financing market in these selected countries does not have separate ROE and ROA indicators. However, in the portfolios of banks, it constitutes a significant share of up to half of some banks' portfolios. The above-mentioned graph shows that, for example, the return on equity of the American banking system was higher than the return on assets, except for one case i.e., 2009, when

ROE assumed negative values of about 0.9%. In general, this indicates a process of leveraging financial results with debt in the form of issued securities. The years 1986–1988 and 2006–2010 were the periods of the largest financial crises, which particularly strongly affected the results of the banking sector and the real estate financing market related to it. In those periods, return on equity decreased by pulling down the return on assets.

Figure 5. Portfolio of insured credit risk in relation to the outstanding value of housing loans

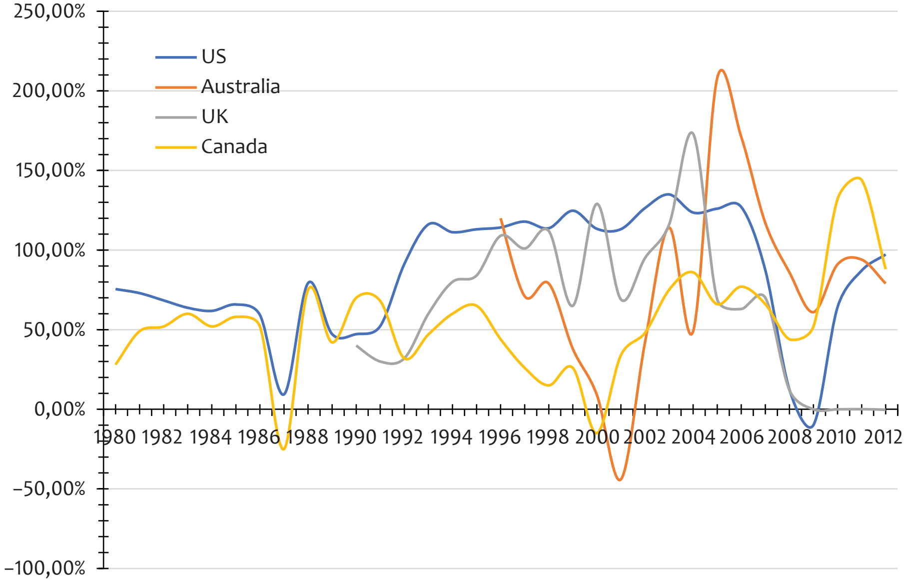


Source: own estimates based on FED, APRA, MICA, FHA, Bank of England, CMHC data.

Similarly to the US, sometimes similar trends in other countries did occur at the same time but with less intensity, but sometimes with more intensity.

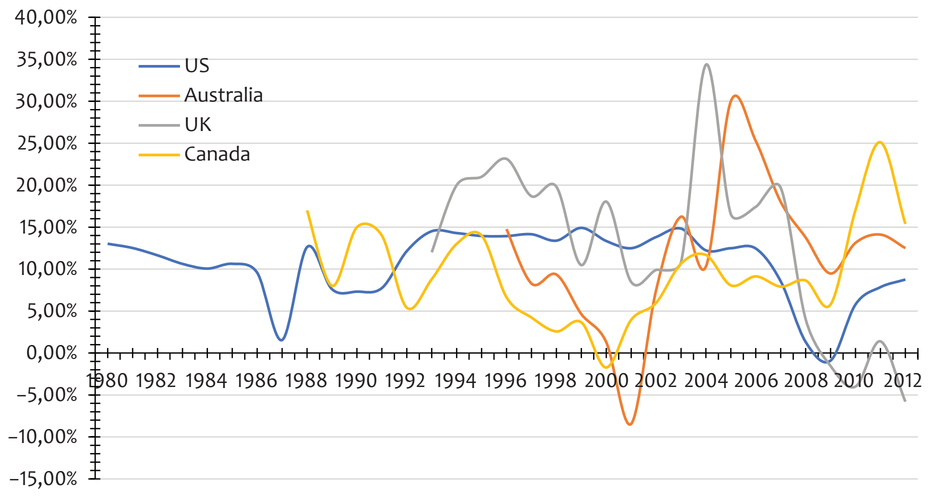
How should insurance companies behave in the times of recession and uncertainty? During such periods, as a rule, the risk margin should grow in line with the rule "the higher the risk, the higher the premiums". The graph below presents data on the primary market of housing loans insured by private insurers in the period from 1982 to 1989. What distinguishes it is the period of recession (1985–1988), during which losses increased but also the reserves increased. It happened as a result of growing contributions, and this is probably the explanation for the proper behavior of insurers. Unfortunately, this was not always the case.

Figure 6. Banking sector's ROA in selected countries



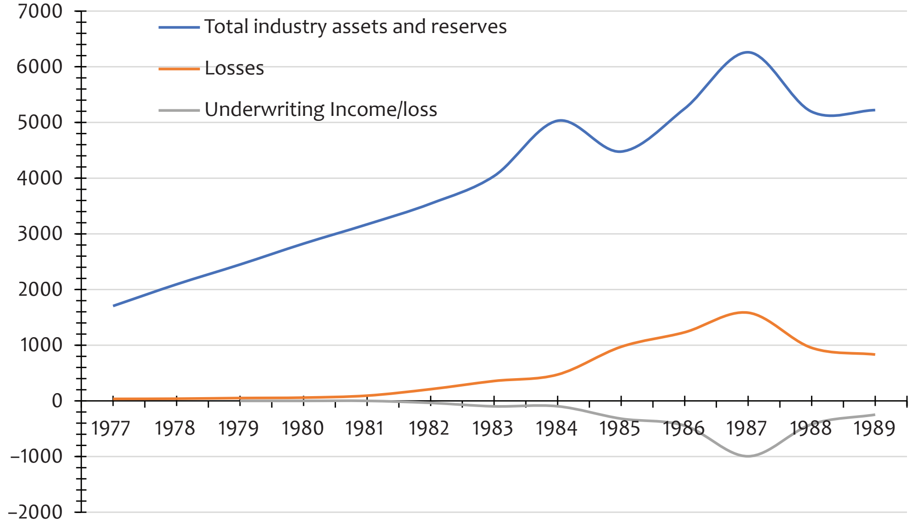
Source: own estimates based on FED, Bank of England data.

Figure 7. Banking sector's ROE in selected countries



Source: own estimates based on FED, Bank of England data.

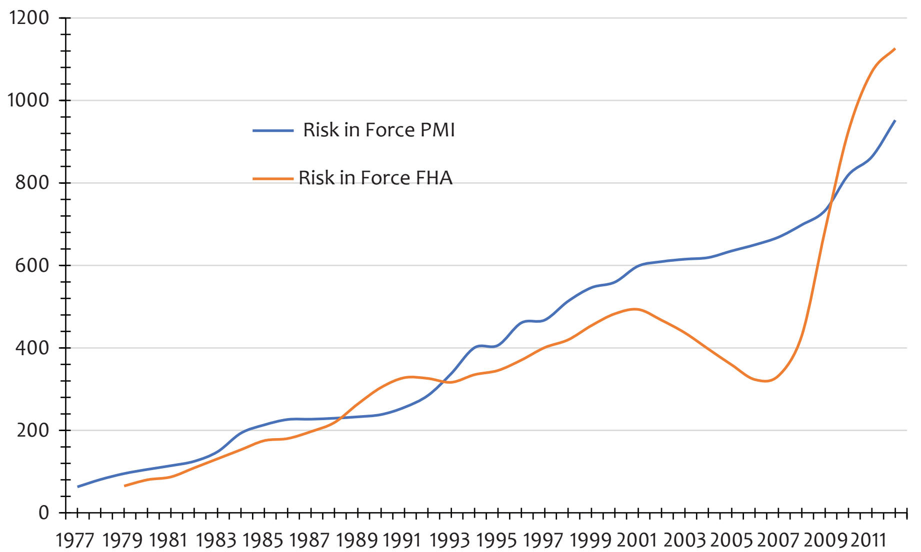
Figure 8. Reserves and other capital of PMI in relation to crises – primary market (mio USD) 1980–1989



Source: own estimates based on MICA, PMI, Urban Institute data.

The above graph is also interesting for another reason. It shows that in a very short time, with a proper cautious policy of shifting credit risk to insurers, one can quickly accumulate reserves for difficult periods i.e., recessions or crises.

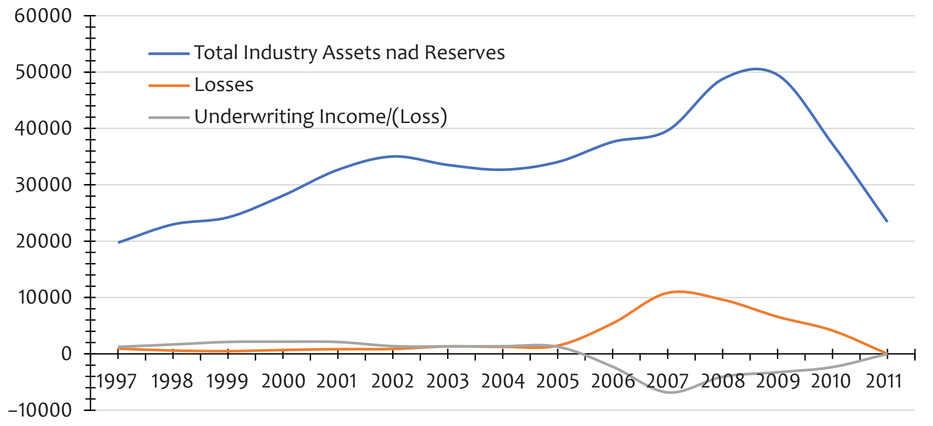
Figure 9. Insured credit risk during the repayment of loans by PMI and FHA in the USA



Source: own estimates based on MICA, FHA, PMI, Urban Institute data.

In the above chart we have presented how much credit risk was insured by private insurance companies (PMI) and government insurers (FHA) in the US. The upward trend of insured loans is visible. Particularly one period deserves attention, namely from 2001 to 2012. The role of FHA in the portfolio of insured mortgage loans decreased significantly, and private insurers increased. Starting from 2008 to 2011, the governmental insurer began to insure more loans and, in the general share of all insurance, overtook private insurers. The following chart explains this sudden change.

Figure 10. Reserves and other capital of PMI in relations to crisises – primary market (mio USD) 1997–2011



Source: own estimates based on MICA, PMI, Urban Institute data.

Private insurers for many years achieving very large profits and having large reserves began to take more and more insurance risks. As a result of risk underestimation, they recorded quite significant losses, which contributed to lowering the level of reserves by more than half, and despite a fairly significant share in the insured credit risk they had to limit their activity. It resulted in a significant increase in the FHA's involvement in the insurance market. The reason for such a sharp change was also the fact that some insurers, as a result of the emergence of new products from the subprime segment, which were tax-favored against mortgage insurance, found themselves under the particular pressure of choosing to take risky products or continue to lose their market. A large part of them chose this first solution and unfortunately entered into transactions on the secondary market creating or engaging in the so-called Bond Insurers. This system from the secondary market acted on the so-called an unregulated market that was not subject to the very strict rules of the US Government Agencies. It ended with a large bubble on the real estate market and the collapse of almost all Bond Insurers and, in effect, pushing some private insurers into serious financial difficulties. It is the reason why government intervention was needed and FHA's engagement was so important.

The stability of insurance systems supporting the mortgage market is shown in the table below. It presents in four selected countries, whether the provision for the risk covered has adequate reserves and whether or not state intervention was required, which resulted in cost for the taxpayer.

Table 5. Estimated losses and reserves of MI programs during reccessions in selected countries

Recessions/Crisis	Losses (cumulative losses during period of recession/ crisis) USD	Reserves + assets at last year of recessions/ crisis- USD	Cost to taxpayers
1978–1985			
The United States	n/a	n/a	n/a
Canada	1, 801.53	41,700.00	n/a
Australia	11, 674.00	142,652.00	n/a
The United Kingdom	n/a	n/a	n/a
1984–1989			
The United States	5,571.17	4,420.46	n/a
Canada	1,978.74	906.49	n/a
Australia	n/a	n/a	n/a
The United Kingdom	n/a	n/a	n/a
2006–2010 subprime			
The United States	36,565.21	14, 068.60	FHA have to be capitalized to extend its share on MI market
Canada	3,694.60	18, 113.00	n/a
Australia	n/a	n/a	n/a
The United Kingdom	n/a	n/a	n/a

Source: own estimates based on MICA, PMI, FHA, CMHC, HLIC, APRA, Bank of England, Urban Institute data.

It was not possible to collect relevant data everywhere. An example of the US is broken here, which has recorded the highest losses in its several decades-long history. At the same time, this cost for the taxpayer would be significantly higher if FHA did not intervene in the housing loan market. The Moodys analysis conducted in 2010 indicated that if FHA ceased to insure mortgage loans from October 1, 2010, it would lead to:

a. The increase in the interest rate of fixed rate loans by approx. 800 basis points.
b. An increase of 4 to 12%, in the case of Freddie Mac and Fannie Mae, of interest rates on loans, which they refinanced in the fourth quarter of 2010.
c. Very negative effects for the economy. The number of flats commissioned would drop to about 300,000 in comparison to 800,000 observed in 2009. Sales on the primary and secondary market would drop to 4 million from the expected level of 6 million.
d. Housing prices would drop by around 25% on average. Such a sharp decline would have had an impact on real GDP, whose growth would drop by about 1.8%, almost three million jobs would be liquidated, and the unemployment rate would increase in the second half of 2011 to 12%.

The above data presents the results for the primary market. The stated examples show that these systems involve large capital and cover a significant part of the housing loan market. They can fulfill their role positively, although during crises and recessions, mistakes and negligence in the area of risk management can seriously undermine trust in them.

4. Examples of insurance markets and their general experience during crises

Since the institutionalization of this system, many experiences have been gathered during which system solutions have been subjected to strong market pressure and the environment in which companies offering a homogeneous insurance product operated. The most classic and well-known examples include[2]:

- US – Great Depression in 1934 – for several decades before the beginning of the Great Depression in the 1930s, the then-growing mortgage insurance sector served both direct lenders and the US secondary mortgage market. Until 1933, all fifty insurance companies based in New York, which underwent mortgage insurance, lost their financial liquidity. Thousands of individual and institutional owners of insurance policies for mortgage-related investments suffered enormous losses. Established to investigate the causes of the mass fall, the office mentioned the following reasons, which in the future became the basis for special regulations:
  - disproportionately low and inappropriate provisions for bad debts;
  - inadequate property valuation;

[2] Some cases discussed with Roger Blood and other MI experts.

  - conflict of interest between the lenders and the mortgage insurers;
  - exaggerated and unjustified investments in real estate and mortgage loans carried out by mortgage insurers, and
  - insufficient supervision.
- US: several insurance companies in the 1970s widened the scope of protection for loans from the commercial real estate segment, such as expensive apartment buildings, stores, office buildings and hotels. As a result of the investment decisions taken, they suffered severe losses. Among the identified reasons of failure one mentioned: the risk of anti-selection on the side of lenders, underestimation by insurance companies of the risk of losses and costs related to servicing this new segment of the market for them.
- US: in 1986, insurance companies collided with a wave of high losses. There were about 20,000 identified defaults in the segment of clients owning flats as well as the multi-apartment segment. In the vast majority of cases, the problem concerned customers from newly built apartments or shortly after their sale, or during construction. Insurance companies have recorded risk concentration in areas connected with the lack of an appropriate minimum borrower's contribution and a conflict of interest. The weakening economic situation also contributed to the occurrence of this risk.
- US: At the end of the 1980s, insurance companies recorded further losses exceeding approximately 1 billion USD in one year. One of these companies lost liquidity despite the relatively high AA rating. This situation resulted from:
  - excessive competition between MI;
  - underestimation of the majority of products covered by MI and the problem in understanding the emerging excess risk;
  - a regional recession at a time with rapidly rising energy prices;
  - introduction of new, more environmentally sensitive mortgage products in a result of deregulation of lenders' activities;
  - a very large number of falsification cases of credit documentation, both on the side of borrowers and lenders;
  - poor assessment of the risk taken over by MI;
  - accepting high loan volumes for insurance in the commercial segment, rather than in the housing segment.
- The US: At the end of the 1980s, a special retention fund administered by the FHA for the risk of failing to pay mortgage loans for the first time in fifty years of its existence lost its liquidity. The reasons are listed above.
- The US: For over twenty years until 1996, FHA allowed loan insurance up to 100% of the loan amount granted. This form of support also concerned

loan cases without starting the debt collection process. This solution resulted in a massive mortgage lending to the FHA and, as a result, it costed the MI fund about 1.5 billion USD. Two thirds of the portfolio of loans covered by this solution had to be directed to debt collection. This solution was abolished in 1996. Since that time, commercial rules have been pursued to solve the problems of borrowers who do not pay back loans.

- The US:subprime crisis 2007.
- Canada: As a result of two large regional recessions in the 1980s, the reserves of the governmental insurer CHMC have been exhausted. CHMC was forced to seek additional funds from the Canadian government. Funds that were supposed to help in financial difficulties were granted in the form of a government loan. As a result of this event, CMHC reserve funds were calculated using the year-to-year method. As in the US, the Canadian government obliged CMHC to provide commercial mortgage insurance. So, from the collected contributions, reserves were be created, and the risk was to be calculated based on the loss ratio of the mortgage portfolio. These reforms have been implemented successfully, thanks to which the premiums for the risk insured increased.
- Canada: in the 1980s, one of the private insurance companies reported very large losses in the energy production region. The amount of these losses was increased by the regional debt collection law, which prohibited taking actions against borrowers. Many borrowers, despite having the ability to pay their debts, left their homes, whose value dropped below the level of loan debt.
- Great Britain: in the 1980s, as a result of increasing economic weakness and a sharp drop in property prices due to a bubble burst, one MI went bankrupt, and many others stopped paying compensation. The reason were the rapidly growing losses, which began to exceed the capabilities of MI companies. Lack of control of the risk taken over and weak lending procedures caused additional losses. As a result of the discussion and the search for solutions to strengthen this program, a separate regulation was finally abandoned and the program was slowly withdrawn from the offer. For more on the reasons, see Duetil 1993.
- South Africa: after the tremendous success of the program implementation in the 1990s, the government's MI program recorded a high level of losses and a sharp increase in operating costs. This government-backed program had fewer options to provide fresh capital than private insurers. Therefore, it had difficulties in providing adequate means to pay compensation.
- The Philippines: This program has been functioning smoothly for over fifty years. After this period, it recorded rapid losses. Lack of liquidity caused

a need of financial support from the government. The reason for the losses were unstable economy and loans, which were granted on a very large scale. Despite the guarantees given in the MI program and government's support, not all claims were satisfied.

- Sweden: The MI program suffered large losses for the insurance risk in the early 1990s. These claims resulted mainly from loans secured on apartments for rent. The reason for the lack of repayment of loans was the revaluation of the collateral property. When the market collapsed, the borrowers lost their ability to repay the loans. In addition, these situations were aggravated by the recession, high taxes and reduced government subsidies for the housing market. Regulatory changes have been introduced concerning the permissible LTV ratio. It helped to keep the losses to a minimum.
- Mexico: FOVI is the name of the MI program that inherited it from another old SHF. The main purpose of this program was to guarantee credit by fifty out of fifty rules. Therefore, the basis for its operation was the transfer of credit analysis process to lenders. This system worked in the 90s of the twentieth century. For many years, this program did not pay any compensation. The main reason were the very restrictive procedures to include lending in this program. Borrowers very rarely used this program, which is why later some criteria were loosened to disseminate it.

5. Detailed recommendations for the Polish market

At the request of USAID in the report entitled "Potential role of mortgage guarantee insurance in supporting the housing financing market in Poland", very interesting conclusions were presented about what actions should be taken in Poland to create a mortgage insurance system. They include:

- Conflict of interest restriction – insurance companies offering mortgage insurance can not be owned or controlled by credit companies. In addition, this category includes all kinds of discounts, like in motor insurance, while in the mortgage insurance risk level cannot be reduced by any incentives. The criterion for selecting the insurer should be determined by the principle of specialization of experience in its reduction and appropriate capital for risk management.
- Business monoline – striving to accurately recognize the catastrophic nature of mortgage portfolio risk. As it has been described, such a risk is characterized by violence, massiveness and high level of losses. Currently, this is not regulated

in our legislation. Virtually every company creates reserves but without recognizing the catastrophic nature of this risk. And the risk as it occurs generates a wave of losses and lasts longer.

- Capital reflecting the level of risk – currently in Polish regulations there is no special treatment of catastrophic risk that may occur on the real estate market. It is mainly about long-term risk that may occur at any time and as a result of macroeconomic changes. In the case of the mortgage real estate market, we are talking about a sharp fall in the value of collateral. Lack of provisions appropriately estimated for risk causes underestimation of capital and may threaten with bankruptcy or with an increasingly limited benefit from insurers.
- Criteria for appraisal and valuation of real estate – it is considered justified that insurers assume the risk of improper property valuation due to fairly strong regulation on the part of the PFSA and the internal procedures at banks.
- Technical reserves – the risk of not paying the mortgage loan must be created on the accounts specially prepared for this purpose. In the US and other countries, funds for this purpose are obtained from premiums for the risk covered. For example,It is 50% of contributions in the US and 25% in Australia. It seems that in Polish legislation such requirements are not necessary,.
- Geographical risk concentration – an insurer accepting insurance for a certain risk must take into account its diversification. Dispersing it in different regions of the country depending on the market, the type of product can help to reduce the negative effects of its implementation. Regional markets are subject to different fluctuations depending on the macroeconomic situation.
- Investments – mortgage insurance companies should not enter into investments outside the statutory area of their activity. Only properties that constitute the registered office of the company and are subject to insurance are allowed.
- Banking – there must be regulations in the banking system that protect the banking sector against the risk of negative selection. Banks cannot define themselves which loans to insure and which not. Otherwise, the mortgage insurance system will not function effectively. It requires two-fold activities that will force the banking sector or set a top-down obligation to insure loans that exceed a certain LTV level e.g., 80%, or assign an appropriate risk weight (smaller) if you have insurance e.g., 50% instead of 100%.

The above recommendations should be supplemented with the reporting of the rules governing insurance companies dealing with risk management. In particular, information about the reserves held for the insured risk, in this case mortgage loans, the amount and value of insured loans. This information will allow independent investors to assess the safety of the country's financial system and will contribute to increasing investments in customer segments and the market that have not been covered by credit action so far.

Conclusions – applications for Poland

It is worth considering which of the above-mentioned solutions can be implementated in our national system. In order to answer this question, one should assess the current functioning of the real estate financing market and the experience gained in this area so far. System of financing the real estate market in Poland has been developing since the 90s of the last century thanks to economic reforms. Nevertheless, this sector is still far from the developed economies of the European Union. It is enough to compare data such as the number of people per apartment, the realtionship of the portfolio financing the real estate market to GDP and the insurance system itself and the diversity of products. In the case of Poland, the housing market is far from Western solutions. This results, in a way, from the following premises.

The real estate financing system started to operate realistically after 2000, when due to the decline in inflation, Poland's investment risk with regard to the prospect of joining the EU began to be lower. Some institutional and organizational changes were also made. After 2005, there was a rapid expansion of the banking sector. There was a significant increase in the prices of flats and real estate caused mainly by the development of bank lending. The supply of new housing did not catch up with it. As a consequence, the sectoral risk increased significantly.

In Poland, three models of real estate market financing have been clashing for years: the German model – based on mortgage banks issuing mortgage bonds, the deposit model – preferred by the majority of universal banks and the Anglo-Saxon model – mostly based on the capital market (securities). In practice, universal banks play a fundamental role. Mixed systems dominate in developed real estate markets, and the refinancing mechanism from the capital market plays an important role. At the current stage of market development it is difficult to say which of the above-mentioned systems will be better. Despite the strong competition, the product offer is poor.

The insurance system plays an important role in this financial market. It is variously developed in individual countries. In some markets, it fulfills a dominant role, while in others it is complementary. In Poland, this system is at the initial stage of development and fulfills the role of the "market prosthesis". It fulfilled a positive role and took the market risk at the initial stage of development. However, this was a risk of underdevelopment due to the bureaucratic ineffectiveness (case of bridge insurance – against high termination in a process of mortgage registration) and its significance will decrease. Therefore, the question arises where is the limit of insurance institutions' increasing their offer and availability of mortgage loans through better credit risk management. Foreign experience shows that the diversification of insurance products is very large, and the range of products is wide: from property insurance, borrower insurance to financial insurance.

Currently, in Poland, insurance products are available which complement the banking offer, such as home insurance against accidental and unfortunate accidents, life insurance for the borrower, and accident insurance. These products also include financial insurance such as: low down payment insurance, bridge insurance, legal title to the real estate. They play a key role by transferring the client's risk to insurance institutions. On the Polish market, thanks to their application (according to conservative estimates), it was possible to increase the number of housing loans granted to the level of approx. two million actively repaid loans. Without them, this number should be reduced by some half million loans.

Thanks to similar products (mainly insurance of legal title to real estate and insurance of low own contribution) on the international markets, the insurance system developed, which took over the risk from banks in difficult times and paid compensation. The created products and funds for the compensation in case of catastrophic damages have been created by unique insurance systems, among which one should distinguish those with the dominant involvement of private or government capital or with the marginal participation of one of them.

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Chapter 8

Proposed methods for modeling the mortgage and reverse mortgage installment

Piotr Śliwka[1]

Introduction

According to the GUS`s document "Poland's population forecast for 2008–2035" (see GUS, 2008), the number of Polish citizens by 2035 will decrease, with the increasing rate of decline, reaching around 35, 993, 000 towards the end of the forecasted period. Anticipated in this context is the dynamic aging of Polish society associated with the further extension of life expectancy resulting in an increase in the percentage of people in post-working age (an increase from 16% in 2007 to 26.7% in 2035). The average life expectancy for men will amount to 77.1 years in 2035 (increase from 73.9 in 2016, see GUS, 2017) and for women 82.9 (increase from 81.9 in 2016, see GUS, 2017). Admittedly, shifting the moment of transition from the period of activity on the labor market to the period of collecting retirement benefits e.g., by two years (from 65 to 67 years) would shorten the payment period, however, it would not significantly affect their amount (especially for women). A common feature of Polish benefits is their lower level than income earned during person's working period. Nevertheless, according to data from the TNS report (see TNS (2016), CBOS (2010)), only 14% of people of working age save for retirement (another 21% do not save, but intend to do so), while 55% do not save or intend to do so. Moreover, 25% of respondents among the listed methods of additional savings for retirement (see TNS (2016), CBOS (2010)) indicate – as the best – investments in real estate, plots and agricultural lands (average age of starting saving: 31 years, people aged 25–45).

Above facts point to the formation of a natural process of prospective search for additional sources of income by future pensioners, using, among others, the

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possibility of transforming illiquid funds accumulated in the form of real estate into liquid financial resources. One of the forms enabling such an operation is a mortgage service (this term will be used to describe both the mortgage pension and reverse mortgage loans in Śliwka and Kulpa (2011), referred to as the "reverse mortgage", as long as it does not lead to misunderstandings) from the ERS group of services (equity release) offered on many markets in Europe and beyond (Hungary, France, Netherlands, Finland, Spain, Germany, Sweden, United Kingdom, USA, South Korea and others).

Currently, two basic versions of ERS exist on these markets: sales (home reversion) and credit (reverse / lifetime mortgage). The first one concerns the transfer of the right to real estate to third parties, at the same time establishing for the seller the right to live in a real estate in exchange for a one-time or periodic annuity based on actuarial methods. The second one is characterized by a loan granted to the beneficiary and secured by a mortgage on his property, whose deferred payment takes place in the moment determined after his death.

The Reverse Mortgage Act (2014), passed by the Polish legislator (Sejm), dated 23 X 2014 enables seniors (in particular lonely and deprived of financial support from potential heirs) to exchange their home's ownership right, for an additional income stream paid periodically, which will improve their financial situation. The act to a certain extent formalizes the problem of the mortgage service and determines who can be its provider and what formal conditions should be met to run it. Although paragraph 4.1 of Chapter 1 of the Reverse Mortgage Act (2014) stipulates that "(…) the creditor provides the borrower for an indefinite period of time with a specified sum of cash, the repayment of which will take place after the death of the borrower and the borrower undertakes to secure the repayment of the sum together with interest due and other costs", however, the following paragraphs do not specify the form of models (in particular models) allowing to determine the amount of installments due to the borrower. What's more, it also does not limit the possibility that a loan provider will use, for example, tools in the field of life annuities to designate the amount of a mortgage installment (although offering a different product than in the Act, but also used on the market).

It is important to point out that the activation of this service is naturally associated with many risks (forecast of real estate prices, average life expectancy, interest rate, commission amount, etc.), which occur on both sides of the contract (the institution servicing the mortgage service and its beneficiaries) and are associated with the total amount of installments paid in relation to the value of the property at the time of sale. In such a situation, it may be:

a) too high, which generates the risk of bankruptcy of the service provider and inability to pay the pension until the recipient's death or
b) too low, which – from the perspective of the beneficiary – means underestimating the amount of the installment i.e., loss (in both cases settable at the end of the service in the event of heirs and no bankruptcy on the part of the service provider).

The paper is organized as follows. Section 1 proposes a model package containing a method for estimating death rates in order to determine the average life expectancy of the beneficiary and a model forecasting the price of 1 sq. m of real estate. In addition, mortgage service modeling was proposed based on: I) life contingent annuity (actuarial approach) and II) annuity certain (debt repayment schedule with modifications). Section 2 presents the amount of the installment paid periodically depending on the chosen method of its designation and the cost of the service with identically defined initial values of the parameters in I) and II). Section 3 summarizes the results.

1. Modeling and forecasting the probability of death q_x and real estate prices

The forecast of the value of real estate necessary to determine the amount of mortgage pension paid in the future is based on the VAR model (VAR – vector autoregressive model: a multi-equation model developed by C. Sims[2], in which each variable is explained by its own delays and delays of other explained variables). The relationship between the price of 1 sq. m was related to the amount of remuneration. Data on transaction prices on the secondary market (six, seven or ten cities) published by the Department of Economic Analysis of the National Bank of Poland seem to be an appropriate time series characterizing changes in prices on the real estate market. However, the moment of the official publication of these data falls on the third quarter of 2006 (2006Q3) i.e., during the intensified housing price increases, which peaked at the turn of 2007/2008 (or in 2008) and were caused by exogenous factors (among others an increase in the demand for a mortgage due to large-scale bank lending, an increase in construction costs caused, among others, by the outflow of employees from the domestic construction market to the foreign

[2] The basic VAR model proposed by C. Sims in 1980 assumes that: all model variables are endogenous, there are no artificial limits to the number of variables in a single equation, and the model is independent of theory as much as possible.

market, etc.). The observed "shock" at the beginning of a series of data significantly influences the proposed model for the price forecast of 1 sq. m. Due to the lack of data from before the construction "boom", a longer series of observations of the price of 1 sq. m of usable area of a residential building put into use published by the Central Statistical Office (since 1998Q4, GUS, 2018a) and the average monthly gross nominal wage in the national economy were ultimately used for the analysis ("Living conditions population" since 2000Q1, GUS, 2018b).

The most important features related to modeling the amount of mortgage service installments include:

a) the length of the benefit payment period (determined by the average life expectancy e_x of the beneficiary, depending on the sex);
b) real estate price (RP) forecast during the payment period;
c) costs related to servicing mortgage.

In the case of a), due to the lack of GUS data regarding e_x from 2018 for women, men and especially the lack of a sufficiently long series of values for both sexes, the data included in the Human Mortality Database (2014) containing, among others, death rates μ_x from 1958–2014 separately for women, men and both sexes of Polish citizens were used. Given the well-known structural changes and, consequently, a change in the methodology of determining μ_x, q_x (probability of death of an x-year-old man in the next year) and ${}_np_x$ (probability of survival of an x-year-old man in the next n years), the 1990–2014 data were finally analyzed. On their basis, ${}_nq_x$ forecasts (probabilities of non-survival by a person aged x-years of the next n years) were determined on the basis of model (1) with non-Gaussian scalar linear filter (NGLSF) described in Śliwka and Socha (2018) (assumptions and shortened derivation of the form included in appendix A). The Lee-Carter model described in Lee and Carter (1992) is commonly used to determine ${}_nq_x$, however the results contained in Śliwka and Socha (2018) showed that the use of NGLSF as:

$$(\ln\mu_x(t))^2 = \left(\alpha_x t\right)^2 + 2\alpha_x\alpha_{0x}t - 2\alpha_x q_{x_2}\frac{\left(\gamma_{x_1}\right)^2}{2\beta_{x_1}}t + c_{0x} \tag{1}$$

where α_x, α_{0x}, β_x, γ_x, q_{x2} are parameters to be estimated and c_{0x} – integration constant, increases the precision of ${}_nq_x$ estimates compared to Lee-Carter model.

In the case of b) forecasting of property prices RP_t in period t was based on the VAR(1) model. It is widely known that real estate price forecasting is a complex problem and mainly dependent on exogenous factors (credit growth, speculative bubbles in the real estate market, etc.) and difficult to predict in the long-term. Therefore, it was assumed that the model should be as simple as possible, but also acceptable from the point of view of statistical quality of the indicators describing its accuracy in relation to empirical data. The estimated form of VAR (1) is given in (2) – (3) (verification of the basic properties of VAR (1) is included in Appendix B):

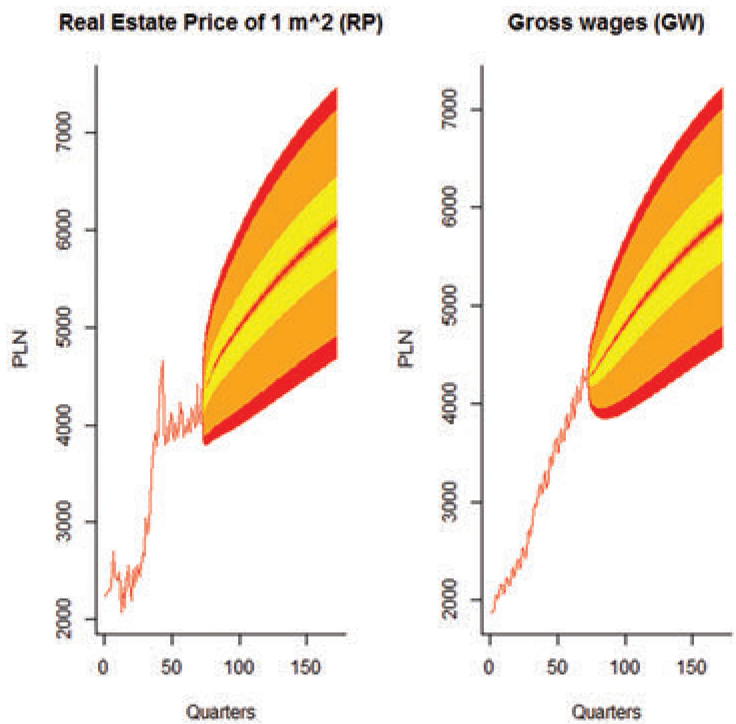
$$RP_t = 107.1727 + 0.8182\ RP_{t-1} + 0.1709\ GW_{t-1} \tag{2}$$

$$GW_t = 42.3362 + 0.0411\ PR_{t-1} + 0.9525\ GW_{t-1} \tag{3}$$

where RP_t – the price of 1 sq. m of the usable area, GW_t – the average monthly gross nominal wage.

Shape of the time series of RP_t and GW_t observations together with forecasts and confidence intervals (median, 90%, 95%) are shown in Figure 1.

Figure 1. Values of time series and forecasts of RP_t and GW_t with respect to the confidence interval (median, 90%, 95%)



Source: own calculations based on GUS, 2018a and GUS, 2018b data.

In addition, on the basis of real estate price forecasts, a one-base index $i_{t/0}=RP_t/RP_0$ (relative to 2017Q4 while maintaining the quarterly real estate price) and chain

$i_{t/t-1}=RP_t/RP_{t-1}$ were determined, whose geometric mean ($i_{ex/0}{}^{GEO}$, $i_{ex/ex-1}{}^{GEO}$) during the appropriate period e_x for a given sex was used to update the value of the property and – as a consequence – the amount of the mortgage installment.

In the case of c), it was assumed that the cost of servicing the loan was included in the interest rate (for simplicity, no additional burdens, such as commissions, fees for preparation and consideration of the application, appraisal of the premises/real estate, etc. were included).

2. Results

In the further part of modeling, the following assumptions were made:

a1) beneficiaries stay in the flat/real estate up to the moment of death (in the case of a mortgage: transfer of ownership to the entity offering this financial service with the possibility of living in a home up to death; in the case of a reverse mortgage: real estate loan), in addition, the portfolio of a company providing such a reverse mortgage contains enough rents / credits so that the risk related to premature death or exceeding the average life expectancy of the recipient reduces the risk of insolvency (the type of risk and the assessment of its level is a broader issue and goes beyond this article),

a2) sale of the flat / real estate follows the death of the (last) owner and at the price valid on the day of sale, in addition the value of the real estate (and not a certain percentage) covers the value of the tranches paid to the recipient and in accordance with the Act, repayment of tranches and possible costs of the institution offering the service by heirs;

a3) beneficiaries take care of the flat, so that its market value in the future does not deteriorate as a result of use (evolves into t along with the RP_t forecast);

a4) the cost of servicing the mortgage service included in the interest rate i_t is fixed (i_t = const) during the duration of service (introduction of the variability of i_t is not a limitation for the methods considered below);

a5) the payout values have been set for annual periods, the calculation of quarterly payments (according to the real estate price) or monthly payments (according to the traditionally accepted payment period) is not difficult using e.g., linear interpolation methods with respect to 1 sq. m and relevant demographic factors (${}_nq_x$, e_x) or assuming that payments occur more frequently than interest rate capitalization.

2.1. Average life expectancy

Based on data from Human Mortality Database – Poland (2014), and formula (1), ${}_tp_x$ for 2018 was determined, and next the average life expectancy (e_x) in years included in Table 1 for selected groups aged (x): 60, 65 and 70 years.

Table 1. The average life expectancy (e_x) in years from 2018

Age \ Sex	Woman	Man	Both
x=60	22	17	20
x=65	18	14	16
x=70	14	11	13

Source: own calculations based on Human Mortality Database–Poland (2014).

2.2. Installment of a mortgage pension

In the next step, we calculated the value of the mortgage paid at the end of each year for a person under the age of x assuming that the payout period coincides with e_x (Table 1), the current value of the pension payable in arrears for n years at a fixed interest rate i_q in the credit version (6) and the n-year life annuity (7):

- $a_{\overline{n}|}$ assuming that the capital at the end of the period n will be equal to the accumulated initial capital together with the sum of accumulated deposits until n in the form of a stream of cash flows at equal intervals for n periods (the service provider pays the beneficiary for n periods a specified amount, and after the expiry of the sale of real estate) (MF) based on Kellison (2008);
- $a_{x:\overline{n}|}$ assuming an n-year (temporary) life annuities taking into account the age of x-years of the beneficiary (MA) based on Bowers et al. (1997).

In the further modeling process, we used:

a) the price of real estate (RV_t) at the start of service (in t = 0) is RV_0 = 300,000 PLN and at the end of the service is RV_{ex} and depends on the value of the property in e_x (as well as gender);
b) R_{RH} determined on the basis of the property value in t = 0 (RV_0 = constant during the service) or in t = e_x(RV_{ex} = const during the service);
c) the base period is the year and the annual interest rate i_q = 1% contains the potential cost of providing the service[3];

[3] Ordinary annuity, i.e., at the end of the period, the m times a year (e.g., monthly payments: m = 12) will take the form: $a_{\overline{n}|}^{(m)} = \frac{i}{i^{(m)}} a_{\overline{n}|}$, whereas annuity due: $\ddot{a}_{\overline{n}|}^{(m)} = \frac{i}{d^{(m)}} a_{\overline{n}|}$.

d) the value of the real estate as a whole intended for payments to the beneficiary i.e., $\beta=1$[4].

Then:

$$a_{\overline{n|}} = \frac{1-v_q^{\ n}}{i_q} \tag{6}$$

$$a_{\overline{x:n|}} = \sum_{k=1}^{n} v_q^{\ k} \, {}_k p_x \tag{7}$$

with the following assumptions:

n – the number of interim payments;

$v_q = \frac{1}{1+i_q}$ – discount factor at the interest rate i_q;

${}_n p_x$ – the probability that a person aged x will survive n years.

The value of the R_{RH} installment paid at the end of the year t was determined considering (6) and (7) respectively

$$R_{RH}^{MF}(t) = \frac{\beta RV_t}{a_{\overline{n|}}} \tag{8}$$

$$R_{RH}^{MA}(t) = \frac{\beta RV_t}{a_{\overline{x:n|}}} \tag{9}$$

n – number of expected life years depending on the sex ($n = e_x$);

RV_t – real estate value at the moment t.

The amount of the R_{RH} pension (R_{RH} = const during the service) was determined in four cases:

CI) $R_{RH}^{MF}(0)$ based on the value of the fixed property RV_0 during the service (t=0, RV_0=const in e_x), regarding the principle of equivalence of the discounted payment sequence (MF);

CII) $R_{RH}^{MA}(0)$ on the basis of the value of the fixed property RV_0 during the service (t=0, RV_0=const in e_x) including the life annuity account (MA);

CIII) $R_{RH}^{MF}(e_x)$ based on the value of RV_{ex} real estate forecasted at the end of the service ($t=e_x$, RV_{ex}=const in e_x) taking into account the principle of equivalence of the discounted payment sequence (MF);

[4] It is usually assumed that $\beta \approx ½$ of the property value at $t = 0$ (possibly $\beta \leq ½$), which naturally reduces the value of the estimated property and consequently lowers the scale of the paid rate of R_{RH}, where (1-β) RV_t can express the cost incurred by the service provider for the mortgage loan.

CIV) $R_{RH}^{MA}(e_x)$ based on the RV_{ex} real estate value projected at the end of the service ($t=e_x$) including life pension account (MA) is included in Table 2.

Table 2. Yearly mortgage pension R_{RH} (PLN)

SCENARIO	AGE	WOMAN	MAN	BOTH
CI)	60	15,259.12	19,277.42	16,624.59
	65	18,294.61	23,070.35	20,383.38
	70	23,070.35	26,654.64	24,724.45
CII)	60	18,291.84	24,930.30	20,885.72
	65	22,522.56	30,575.77	26,012.50
	70	29,186.91	38,842.42	32,686.38
CIII)	60	21,054.12	25,458.16	22,489.37
	65	24,341.28	29,418.02	26,572.58
	70	29,502.31	32,868.82	31,065.49
CIV)	60	25,238.60	32,923.49	28,253.71
	65	29,966.62	38,988.51	33,910.92
	70	37,324.15	47,898.03	41,069.41

Source: own calculations.

2.3. Proposal to designate a "reverse mortgage" installment

In the classic Mortgage Loan Amortization Schedule it is assumed that the fixed installment R of loan K taken by the borrower for n periods is determined by $R=K/a_{\overline{n|}}$ and divided into R_O and R_K i.e., $R = R_O + R_K$, where R_O is the interest part of the installment (calculated e.g., in relation to the outstanding balance), R_K – the capital part that repays the loan capital, and K – the debt balance. In this subsection a modification of the classic scheme presented above is proposed. Assumption was made that the loan K divided by the number of periods for which it was allocated determines the installment R which repays the debt balance. Similarly to the classical scheme, the installment $R = R_O + R_K$, that is, it consists of the "interest" part of R_O and the "capital" R_K, in which case the "capital" part is designated as "benefit recipient".

The procedure for determining the R_{RH} installment of the "reverse credit" is as follows:

K1. the value of the RV_t property (e.g., at time $t = 0$) is divided into the number of installments equal to the beneficiary's e_x ($RV_t / e_x = R_t$);

K2. Rt has been divided into the "interest" part of $R_{O,t}$ (describing the "cost" of the institution, e.g., related to the service) and the "capital" part paid to the recipient of $R_{RH,t}$ i.e.,:

$$\frac{RV_t}{e_x} = R_t = R_{O,t} + R_{RH,t} \tag{9}$$

where $R_{O,t} = i_t S_t$ or $R_{O,t} = i_t R_t$ and
St – the balance of the amount of credit remaining to be paid to the beneficiary at time t (if $R_{O,t} < R_t$)[5], at the start of the service $S_0 = RV_0$ (in t = 0) and $S_t = S_{t-1} - R_t$;
K3. $R_{RH,t}$ was designated as $R_{RH,t} = R_t - i_t R_t$;
K4. periodically paid RRH beneficiaries were averaged $R_{RH,t}$ relative to e_x

$$R_{RH} = \frac{\sum_{t=1}^{e_x} R_{RH,t}}{e_x}. \tag{10}$$

The following scenarios for the determination of Rt (interest rate *i*=const during the mortgage service) were considered:

SI) RV0 – the value of the property at the start of the service and $R_{O,t} = i_t S_t$, where

$R_t = \frac{RV_0}{e_x} \; \forall t \in e_x$;

SII) RV0 – the value of the property at the start of the service and $R_{O,t} = i_t R_t$, where $R_t = \frac{RV_0}{e_x} \; \forall t \in e_x$;

SIII) $RV_t^{i_{ex/0}^{GEO}} = i_{e_{x/0}}^{GEO} RV_0$ – property value in the period e_x taking into account the $i_{ex/0}^{GEO}$ index in relation to the initial real estate price RV_0 for a person aged x years: $R_t^{i_{ex/0}^{GEO}} = \frac{i_{e_{x/0}}^{GEO} RV_0}{e_x}$;

SIV) $RV_t^{i_{t/t-1}} = i_{t/t-1} RV_{t-1}$ – real estate value in the period e_x considering the $i_{t/t-1}$ index in relation to the price of RV_{t-1} real estate from the t−1 period for a person aged x years: $R_t^{i_{t/t-1}} = \frac{i_{t/t-1} RV_{t-1}}{e_x} \; \forall t \in e_x$.

[5] The situation is analogous to the mortgage loan amortization schedule, in which the R_t installment is determined on the basis of the quotient S_t (debt balance at t) and $a_{\overline{n-t|}}$ (for n−t periods).

The R_{RH} values given by the formula (10) on the basis of the above scenarios are included in Table 3 (similarly: $RV_0 = 300{,}000$ PLN, $i_q = 1\%$):

Table 3. Yearly installments R_{RH} of a reverse mortgage loan (PLN)

SCENARIO	AGE	WOMAN	MAN	BOTH
SI)	60	12,068.18	16,058.82	13,425.00
	65	15,083.33	19,821.43	17,156.25
	70	19,821.43	23,375.00	21,461.54
SII)	60	13,500.00	17,470.59	14,850.00
	65	16,500.00	21,214.29	18,562.50
	70	21,214.29	24,750.00	22,846.15
SIII)	60	14,687.52	18,977.11	16,120.02
	65	17,912.02	22,901.58	20,104.12
	70	24,193.40	26,448.07	24,567.57
SIV)	60	12,967.31	16,991.72	14,339.22
	65	16,010.80	20,761.55	18,093.38
	70	20,761.55	24,305.79	22,399.04

Source: own calculations.

2.4. Economic result

On the basis of the value of installments in Tables 2–3, the total amount paid to the beneficiary $\sum_{t=1}^{e_x} R_{RH,t}$ was determined and compared to the value of the RV_{ex} real estate for cases CI) -CIV) and SI) -SIV) at the end of the e_x period (the moment of property valuation and its potential sale). Table 4 shows the difference between the value of real estate at the end of the service and the amount paid during its lifetime (economic result): $ER_x^B = RV_{e_x} - \sum_{t=1}^{e_x} R_{RH,t}$ in the case of "BOTH" (the obtained ER_x^B result can be, for example, rescaled with the coefficient determined from R_{RH}^B/R_{RH}^K or R_{RH}^B/R_{RH}^M from Tables 2–3 getting the right value for women or men).

The results presented in Table 4 indicate that depending on the time of the real estate valuation and from the beneficiary point of view, the most advantageous method of R_{RH} installment calculation is offered by the CIV) scenario with $R_{RH}^{MA}(e_x)$ based on the n-year life annuity and taking into account the projected value of the property at the end of its duration: $ER_{ex}^{B} > 0$ i.e., the value $\sum_{t=1}^{e_x} R_{RH,t}$ of the installments paid in the case of a person of age x significantly exceeds the amount of RV_{ex} obtained from the estimated sale of real estate at the end of the mortgage service. In the case of the service provider, the most advantageous scheme is offered by SI), in which the R_{RH} installment was determined on the basis of the RV_0 real estate price at the start of the mortgage service, thus excluding the change in the RV_t property price during the service period.

Table 4. Economic result ER_x^B for sex "BOTH" during e_x (in PLN)

SCENARIO	C			S		
	x=60	x=65	x=70	x=60	x=65	x=70
I)	83,728.18	68,416.99	66,894.12	145,720.90	119,503.40	107,811.27
II)	1,167.90	–20,693.63	–32,949.07	118,111.23	97,242.05	90,448.09
III)	–29,903.15	–29,559.86	–12,622.99	60,352.13	46,751.30	48,985.32
IV)	–141,588.43	–145,727.94	–138,072.90	99,257.48	81,703.36	78,279.23

Source: own calculations.

Conclusions

Based on the results in Tables 2 and 3, the following conclusions can be drawn:

1. The amount of R_{RH} annuities determined in scenario C) is higher (more favorable for the beneficiary) in relation to a fixed person at the age x and sex in relation to S), which results from the adoption of a different methodology proposed for determining the R_{RH} installment.
2. The RRH values determined in CII) -CIV) are more beneficial for the beneficiary (except for a 60-year-old person in CII)) with assumed $i_q = 1\%$ compared to CI) and SI)-SIV) scenarios, which results from two facts:
   2a) a low interest rate, the increase of which causes a decrease in the ER_{ex}^{B} value in the case of scenarios C);
   2b) the moment of property valuation.
3. An increase in the interest rate on the loan balance increases the cost of the loan, however, with a high interest rate and a suitable property price, it may happen that $R_O > R_t$, especially at the beginning of the mortgage service, which may require additional assumptions regarding the correct determination of R_{RH}.

4. The results in Table 4 indicate a significant differences between the methods of determining the R_{RH} installment, the moment of property valuation and the risk involved both on the part of the recipient and the service provider:
   4a) in the cases CII) -CIV), omitting a person aged 60, the service provider loses, which may result in insolvency of the company providing the service and, consequently, withholding payments R_{RH} before e_x (this is partly due to the assumption that coefficient β=1, so it is possible to find such a β for which $ER_x = 0$);
   4b) in the cases SI) -SIV), the beneficiary loses, however, changing an unsaleable asset for a stream of periodic and constant income gives him a chance to improve his financial situation.

The above conclusions lead to further work clarifying the form of R_{RH}.

To sum up, the aim of this article was to present the methods of modeling the mortgage pension and reverse mortgage based on the estimation of the actuarial model parameters (${}_tp_x$ and e_x) and the econometric model (forecasting the price of 1 sq. m of real estate using VAR(1)). The proposed modeling does not fully cover the above issue. The use of advanced theory of stochastic processes for modeling the real estate market, additional variables and the construction of life expectancy tables, concern for the current civilization causes of premature mortality (e.g., due to cancer) should provide more precise estimates of R_{RH} values. The article considers the situation of an individual customer. In the case of a portfolio consisting a sufficiently large number of beneficiaries, it is necessary to analyze the risk of the "solvency" of the portfolio, which should be the subject of future research.

The given proposals do not exhaust the possible methods of determining the installment value (e.g., they do not include the discounted payment sequence in which the internal rate of return is the measure of the choice of the R_{RH} determination method) and are treated as basis for further considerations (taking into account e.g., the change in money over time, real volatility "Cost" of the loan, additional burdens resulting from servicing the mortgage service, etc.), which will make it possible to clarify the Reverse Mortgage Act (2014), in particular protecting people unaware of the risks associated with the modeling of the mortgage service under consideration.

Appendix A

Model with a continuous non-Gaussian scalar linear filter

We consider a family of mortality model with a continuous non-Gaussian scalar linear filter described by

$$\mu_x(t,l)=\mu^l_{x_0}e^{\alpha^l_x t+\sum_{i=1}^{3}q^l_{x_i}y^i(t.l)} \tag{A1}$$

$$dy(t,l)=-\beta^l_{x_1}y(t,l)dt+\gamma^l_{x_1}dW(t)$$

Introducing new variables $y_1(t,l) = y(t,l)$, $y_i(t,l) = y_i(t,l)$ and applying Ito formula we obtain

$$dy_2(t,l)=\left(-2\beta^l_{x_1}y_2(t,l)+\left(\gamma^l_{x_1}\right)^2\right)dt+2\gamma^l_{x_1}y_1(t,l)dW(t)$$

$$dy_3(t,l)=\left(-3\beta^l_{x_1}y_3(t,l)+3\left(\gamma^l_{x_1}\right)^2y_1(t,l)\right)dt+3\gamma^l_{x_1}y_2(t,l)dW(t)$$

where $\mu_x(t, l)$ is a stochastic process representing a mortality rate for a person aged x at time t,
α^l_x, β^l_x, q^l_{xi} (i=1,2,3), μ^l_{x0} and γ^l_x constant parameters, W (t) is a standard Wiener process, σ (t): $R^+ \to S$ be the switching rule, where S = {1,…,N} and $l \in S$. Taking natural logarithm of both sides of Equation (A1) and applying Ito formula we find

$$d\ln\mu_x(t,l)=[\alpha^l_x-\left(\beta^l_{x_1}q^l_{x_1}-3\left(\gamma^l_{x_2}\right)^2\right)y_1(t,l)-(2\beta^l_{x_1}q^l_{x_1}-6\left(\gamma^l_{x_2}\right)^2)y_2(t,l)-\left(\gamma^l_{x_2}\right)^2$$

$$-3\beta^l_{x_1}q^l_{x_3}y_3(t,l)]dt+[\gamma^l_{x_1}q^l_{x_1}+2\gamma^l_{x_1}q^l_{x_2}y_2(t,l)+3\gamma^l_{x_1}q^l_{x_3}y_3(t,l)]dW(t)$$

Rewriting moments in the form of equations (only the first and the last moment equations will be presented):

$$\frac{dE\left[z_{x_1}(t,l)\right]}{dt}=\alpha^l_x+q^l_{x_2}\left(\gamma^l_{x_1}\right)^2-\left(\beta^l_{x_1}q^l_{x_1}-3q^l_{x_3}\left(\gamma^l_{x_1}\right)^2\right)E\left[z_{x_2}(t.l)\right]-$$

$$-2\beta^l_{x_1}q^l_{x_2}E\left[z_{x_3}(t,l)\right]-3\beta^l_{x_1}q^l_{x_3}E\left[z_{x_4}(t,l)\right]$$

$$\ldots$$

$$\frac{dE\left[z_{x_4}^2(t,l)\right]}{dt}=6\left(\gamma_{x_1}^1\right)^2 E\left[z_{x_2}(t,l)z_{x_4}(t,l)\right]+9\left(\gamma_{x_1}^1\right)^2 E\left[z_{x_3}^2(t,l)\right]-6\beta_{x_1}^1 E\left[z_{x_4}^2(t,l)\right]$$

and using the method of the moment equations we find the nonstationary solutions of the first and second moment of the process (see Śliwka and Socha (2018), Appendix 3 – Appendix 4).

$$E\left[z_{x_1}(t,l)\right]=\alpha_x^1 t+\alpha_{0x}^1$$

$$E\left[z_{x_1}^2(t,l)\right]=(\ln\mu_x(t,l))^2=\left(\alpha_x^1 t\right)^2+2\alpha_x^1\alpha_{0x}^1 t-2\alpha_x^1\frac{\left(\gamma_{x_1}^1\right)^2}{2\beta_{x_1}^1}t+c_{0x}^1$$

where $\alpha_{0x}{}^1$ and $c_{0x}{}^1$ are constants of integration.

Appendix B

Vector Autoregression Model (VAR) – a formula and verification of the basic assumptions of the model (Greene (2018)).

B1 Model's form and its basic characteristics (the standard error in round brackets and p-value in square brackets are given under the values of the parameter estimates)

$$\begin{array}{llll} RR_t = & 0.81821\ RP_{t-1} & + 0.17094\ GS_{t-1} & + 107.17272 \\ & (0.06977) & (0.07412) & (98.21182) \\ & [<2e\text{-}16] & [0.0242] & [0.2790] \end{array}$$

Residual standard error = 192.3 (on 68 degrees of freedom); Multiple $R^2 = 0.9434$ (Adj $R^2 = 0.9417$); F-statistic = 566.4 (on 2 and 68 DF; p-value: < 2.2e-16)

$$\begin{array}{llll} GS_t = & 0.04105\ RP_{t-1} & + 0.95250\ GS_{t-1} & + 42.33615 \\ & (0.03734) & (0.03966) & (52.55484) \\ & [0.275] & [<2e\text{-}16] & [0.423] \end{array}$$

Residual standard error = 102.9 (on 68 degrees of freedom); Multiple $R^2 = 0.9819$ (Adj $R^2 = 0.9814$); F-statistic = 1846 (on 2 and 68 DF, p-value: < 2.2e-16)

B2 Roots of the characteristic polynomial: 0.9927 and 0.778 smaller than 1 (a higher order of VAR provides a lack of stationarity).

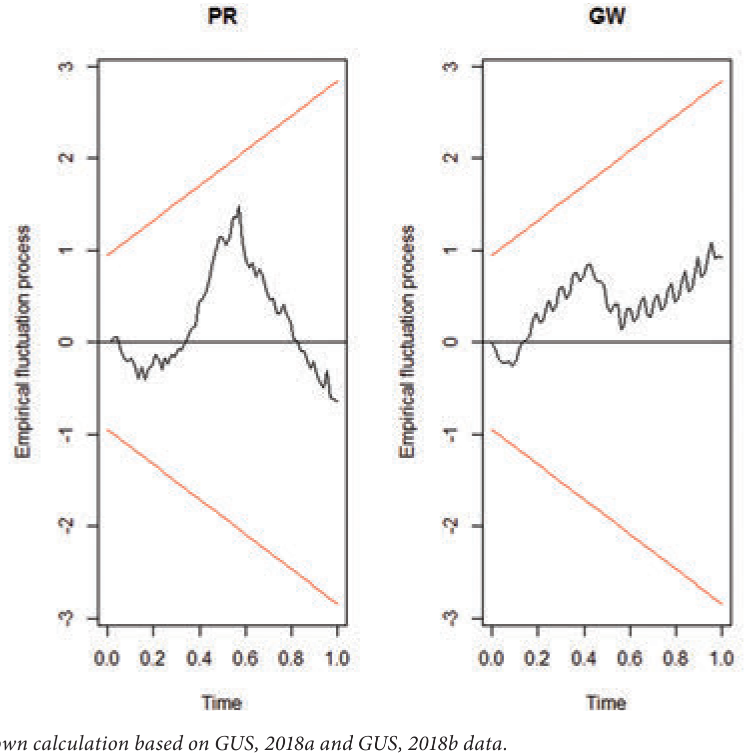
B3 Serial correlation Breusch–Godfrey test: χ^2=3.7327 (df=4, p-value=0.4434) – no autocorrelation.

B4 ARCH test: χ^2= 108.17 (df=90. p-value = 0.09319) – no ARCH effect.

B5 JB test: χ^2=1.9995 (df=4, p-value = 0.7358) –normally distributed random errors.

B6 Stability: results included in the confidence interval – the condition fulfilled.

Figure 2. Empirical fluctuation process of RP_t and GW_t



Source: own calculation based on GUS, 2018a and GUS, 2018b data.

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Chapter 9

US housing finance policy in the aftermath of the crisis

Michael Lea[1]

Introduction

The causes and consequences of the US mortgage market meltdown have been extensively analyzed and debated over the past decade. The Financial Crisis Inquiry Commission issued a 662-page report analyzing the causes of the crisis in 2011 (FCIC 2011). The Commission's majority report identified many contributors to the crisis focusing on regulatory failure to spot and stop excessively risky practices. They pointed to the collapse in mortgage lending standards, lack of oversight of the derivatives market, lack of regulation of the shadow banking system allowing extraordinarily high leverage and off-balance sheet finance, a flawed rating agency model and failures of corporate governance and risk management as the primal causes of the crisis.

With a crisis of this magnitude it is not surprising that there are conflicting views on its causes. The Commission's report contained two minority views. The first emphasized the global nature of the crisis pointing to housing bubbles and financial firm failures in other countries (Hennessey et. al. 2011). The major causes of the crisis included a credit bubble fueled by low interest rates and imported capital, a housing bubble fueled by speculation and lax underwriting of mortgage loans, non-traditional mortgage instruments designed to improve initial affordability, incentive misalignments for participants in the mortgage market, government housing policy supporting mortgage lending to low and moderate income households, dependence on securitization for funding and excessive leverage in large financial institutions.

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A second dissenting view focused on government housing policy to channel funds to low and moderate-income borrowers (Wallison, 2011). The government-sponsored enterprises (GSEs), Fannie Mae and Freddie Mac, were subject to housing goals that mandated that a majority of their purchases be for loans to borrowers at or below area median income. Depository institutions were subject to the Community Reinvestment Act that encourages them to provide loans in proportion to the deposits they receive in areas they lend with focus on low and moderate-income neighborhoods.

The purpose of paper is to review the policy responses to the US mortgage market crisis and assess how much the market has changed. In section one we briefly review the causes of the mortgage market crisis. Our focus is not to come to a particular answer but rather to create a context for the subsequent policy initiatives undertaken in the name of housing finance reform. In section two we review the major legislative and regulatory actions taken since 2008 to reform the housing finance system linking them with the contributors to the crisis. Our final section provides an assessment of the impact of policy changes to date and observations on the way forward.

The major conclusion of the paper is that despite record levels of distress and taxpayer bailouts of major housing finance institutions little has changed in the US. The government sponsored enterprises and guarantee providers still dominate the market. The long-term fixed rate mortgage is still the overwhelming mortgage instrument provided to consumers. Sub-prime and Alt A (limited documentation) lending are creeping back on the fringes of the market. The Dodd-Frank financial regulation and reform legislation has created a massive increase in compliance costs for lenders with a corresponding constriction of credit.

There has been a significant tightening of underwriting of mortgages. This has been accomplished by new regulations and actions forcing lenders to repurchase mortgages. Average FICO scores for newly originated loans are much higher than before the crisis and loans now must be fully documented[2]. A requirement that lenders ensure a borrower's ability to repay is surely a step in the right direction.

However, the prescriptive nature of legislation dealing with mortgage product characteristics has limited the choices available to consumers. While non-traditional and risky affordability products largely disappeared from the market, they are beginning to return, offered by non-bank lenders. We may see more of such products as the Federal Reserve tightens monetary policy. There have been a number of

2 FICO (Fair Isaac Company) is the principal credit scoring methodology used in US mortgage lending.

policy initiatives dealing with mortgage defaults – some successful and others not. Legislative and judicial actions to deal with mortgage distress may have weakened the collateral value of housing.

US private label mortgage securitization has yet to rebound reflecting regulatory uncertainty and the dominance of the GSEs. There has been little movement towards creating a legislative basis for covered bonds. Important aspects of the Dodd-Frank legislation such as risk retention were not fully implemented and the GSEs have yet to be reformed.

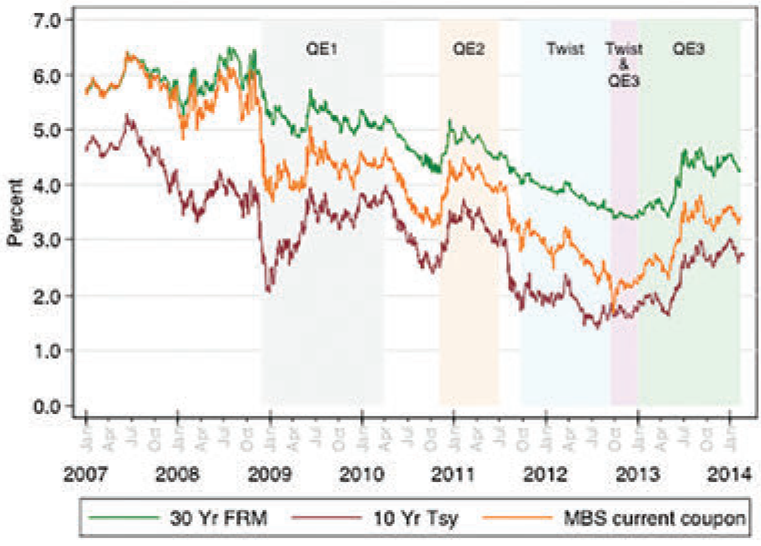
It is perhaps not surprising that significant change has not occurred in the US housing finance system. The political allure for supporting housing and homeownership remains strong and the incentives of lenders to maximize volume and market share continue to exist. The continued dependence of the economy on housing and the availability of relatively cheap mortgage credit provide strong support for continued government involvement and suggests that important lessons about the causes of the crisis have not been learned and a repeat of the boom and bust could happen.

2. The government response to the mortgage meltdown

Monetary Policy: There have been many initiatives to address the crisis. The most important has been Federal Reserve actions to reduce mortgage interest rates. The Federal Reserve has run an exceptionally accommodative monetary policy since the onset of the financial crisis in 2008. In addition to keeping short-term interest rates near zero, the Fed conducted several rounds of "quantitative easing" (QE) in which it purchased long term Treasury and mortgage-backed securities (MBS) that helped keep long term fixed rate mortgage rates exceptionally low (Figure 1). Research by Krishnamurthy and Vissing-Jorgensen (2011) and Patrabanash, Doerner, and Askin (2014) found that QE1 and 2 lowered mortgage rates encouraging borrower refinance stimulating the economy. QE1 had a larger effect than subsequent rounds in part as QE1 involved large purchases of agency-backed MBS.[3] QE2 in contrast involved only Treasury security purchases.

[3] However, Stroebel and Taylor (2012) find that the Federal Reserve's mortgage purchase program under QE had little impact on mortgage spreads. The attribute the decline in spreads to changes in prepayment and default risk in mortgages.

Figure 1. US mortgage interest rates



Source: Patrabanash, Doerner, and Askin 2014.

Bauer (2012) looked at three rounds of QE. He found that although the policy lowered rates on targeted securities and private lending its effects weakened over time and were undermined by actions in the mortgage market. He found that the spread between conforming mortgage rates and GSE mortgage security yields rose after the crisis. He attributes this to lessened competition in the mortgage market leading to increased margins and pricing power by originators. Another factor in rising spreads was the increase in guarantee fees and pricing adjustments by the GSEs. The average "G" fee rose from around twenty basis points prior to the crisis to more than fifty basis points currently[4]. Also, the GSEs have applied adverse market and loan level pricing adjustments that have reduced the price they pay for a given coupon mortgage.

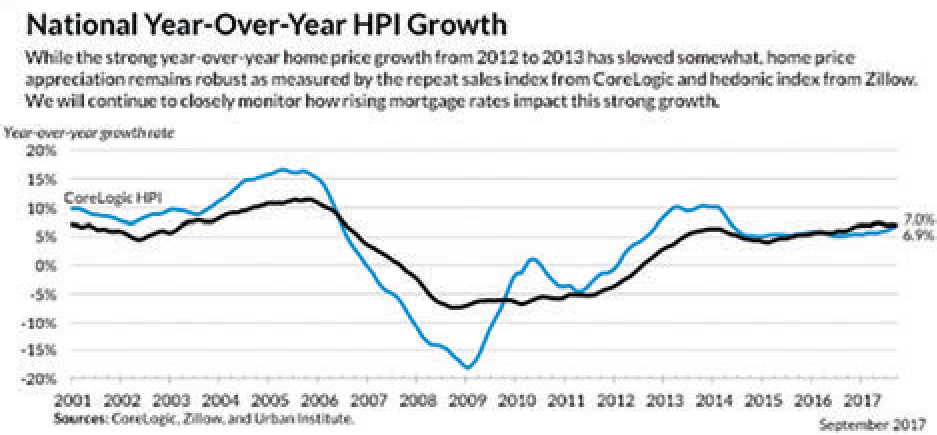
The extraordinary accommodation ended with the May 2013 announcement that the Fed may begin to reduce its purchases of MBS (the "taper") that resulted in a one-percentage point rise in the long-term fixed rate mortgage rate. Refinancing activity slowed significantly, from an origination share of 80% from 2009–13 to a 35% share in 2017. Mortgage origination volume has been at or below 2 trillion USD per year since 2007, a significant decline from the first half of the decade. This decline puts a great strain on the industry. Mortgage companies laid

4 https://www.fanniemae.com/content/pricing/llpa-matrix.pdf

off thousands of staff in response to the decline in activity. Most production staff are paid on commission and the decline in market activity puts pressure on the credit departments of lenders to relax underwriting standards – a feature of the market in the wake of the record 2003 refinance boom.

Another objective of QE was to re-inflate the housing market the crash of which is responsible for much of the loss from the financial crisis. As shown in Figure 2, house prices have indeed rebounded, rising by more than 10% in many markets. National house prices resumed positive growth in 2012 and are now rising at 7% per year. Double digit annual increases in several major metropolitan markets have led some analysts to warn of an impending house price bubble[5].

Figure 2. House price growth



Source: Urban Institute 2017.

Rising mortgage rates and house prices have impacted demand, reducing affordability in an environment of limited wage growth. The inventory of existing houses for sale has been flat or falling and new construction has been weak and oriented towards luxury single-family or multi-family rental. The relative lack of supply along with pent up demand has increased pressure on house prices.

Regulation: The US government has attempted to deal with the causes of the meltdown with a slew of new mortgage regulations focusing on tightening underwriting and eliminating "dangerous" products. The most significant action was the passage of the *Dodd–Frank Wall Street Reform and Consumer Protection Act* in July 2010. Dodd-Frank is a wide-ranging bill covering many of the parts

5 http://www.businessinsider.com/the-us-cities-with-the-biggest-housing-bubbles-2017-8

of the financial system. The mortgage specific aspects of Dodd-Frank address mortgage underwriting, products, disclosure, lending practices and securitization. The legislation also created the Consumer Financial Protection Bureau (CFPB) that centralizes consumer financial protection in one agency[6]. Notably it did not address the future of the GSEs.

Dodd-Frank had a number of mortgage specific provisions. In particular, it mandated regulators to create a class of very safe mortgages that would enjoy legal and regulatory protection and an even safer mortgage that would be exempt from risk retention by lenders that sell the mortgages.

Qualified Mortgages*:* The Dodd-Frank Act has two definitions of mortgages: qualified mortgages ("QM"), defined by the CFPB and focusing on a borrower's ability to pay; and qualified residential mortgages ("QRM"), defined by six financial regulatory agencies, focusing on mortgages with underwriting and product features related to the probability of default[7]. A qualified mortgage gives lenders a "safe harbor" against future litigation, while a qualified residential mortgage is exempt from risk-retention requirements associated with issuing mortgage-backed securities.

A qualified mortgage is a home loan that meets certain standards set forth by the federal government. Lenders that generate such loans will be presumed to have also met the Ability-to-Repay rule mandated by the Dodd-Frank Act[8],[9]

QM requires:

- Full documentation;
- No interest-only (IO) or balloon payments;
- No negative amortization;
- Term of 360 months or less;
- Back-end (all-inclusive) debt-to-income ratio (DTI) of 43% or less[10];
- Prepayment penalties of three years or less;

6 Despite concern about regulatory fragmentation in the US, Dodd-Frank did not materially change the institutional landscape. The Office of Thrift Supervision was abolished and the CFPB created.

7 https://www.nixonpeabody.com/en/ideas/articles/2013/02/26/qualified-mortgages-vs-qualified-residential-mortgages

8 Before making a mortgage loan, a creditor must make a reasonable and good faith determination, at or before consummation, of a consumer's ability to repay the loan according to its terms. Lenders must measure the borrower's ability to repay the principal and interest over the long term, not just during an introductory period when the rate might be lower. The ability-to-repay rule requires loan originators to document income, debts, and other underwriting factors. CFPB has put out detailed regulations on how lenders should determine ability to pay. See www.qualifiedmortgage.org/ability-to-repay

9 There is an exemption from the 43% DTI limit, rate cap and balloon payment prohibition for "small creditors" defined as lenders making 500 or fewer first mortgages, having 2 billion USD or less in total assets and holding loans in portfolio for 3 years (Benton and Bell 2015).

10 The debt-to-income ratio compares the amount of money a person earns each month (gross monthly income) to the amount he or she spends on recurring debt obligations including property tax, insurance and homeowner association dues if applicable.

No excessive upfront points or fees: the points and fees paid by the borrower must not exceed 3% of the total amount borrowed[11].

Lenders that generate QM-compliant mortgage loans receive a degree of legal protection against borrower lawsuits. The level of protection they receive depends on the type of loan they make. There are two types of QM loans:

Safe Harbor — Of the two types of QM loans, this one gives lenders the highest level of legal protection. These are lower-priced loans with interest rates closer to the prime mortgage rate. They are typically granted to consumers with good credit history (less risk). If the borrower ends up in default/foreclosure down the road, the lender making a safe harbor QM loan will be considered to have legally satisfied the Ability-to-Repay rule. Thus, it will be harder for the borrower to sue the lender in court. However, borrowers can still challenge their lenders in court if they feel the loan fell short of the QM parameters outlined above.

Rebuttable Presumption — These are higher-priced loans that are typically granted to borrowers with lower credit scores. In this context, 'higher-priced' refers to a loan with an interest rate that is more than 1.5 percentage points higher than the current prime mortgage rate[12]. Lenders who grant these types of mortgages receive a type of legal protection known as rebuttable presumption, which offers less protection than the safe harbor explained above. If the borrower ends up in a foreclosure situation, he or she can still win an ability-to-repay lawsuit if they can prove, for example that "the creditor did not consider their living expenses after their mortgage and other debts".

Studies of the effect of QM and the Ability-to-Pay requirement on mortgage origination have been inconclusive. In 2017, the Mortgage Bankers Association (MBA) opined *"considering the significant potential liability and litigation expenses for an ATR violation, many lenders have limited themselves to making only QM safe harbor loans. Those few that do offer non-QM loans charge higher rates in order to offset potential legal and compliance risks, even if the underlying credit risk is relatively low. As a result, some categories of creditworthy borrowers that should qualify for a QM have trouble gaining access to safe, sustainable and affordable mortgage credit"*. Analysis by the Urban Institute (2016) has argued that the mortgage credit box is too tight (before and after implementation of the rules in January 2014) denying credit to otherwise credit worthy borrowers. A survey by the American

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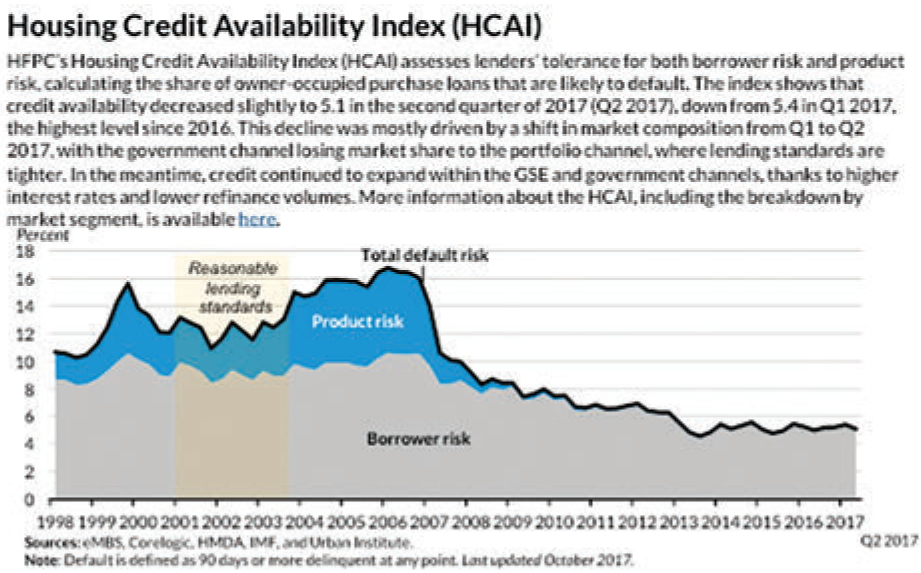
11 In the US, lenders charge points that are in effect pre-paid interest. Points can be positive (paid by borrower to lender) or negative (rebate paid by lender to borrower used to defray other closing costs). Positive points are associated with a lower note rate and negative points a higher note rate.

12 The typical definition of a prime mortgage rate is the one reported by the Freddie Mac Primary Mortgage Market Survey, http://www.freddiemac.com/pmms/

Banker in 2016 found 9% of loans were non-QM (Bernard, 2017) down from 14% in 2015. High debt-to-income levels and insufficient documentation were the most common factors prohibiting mortgage loans from meeting QM standards. The median FICO score at origination has increased by approximately 20 points over the past decade (Urban Institute, 2017).

The Urban Institute has constructed an index of mortgage credit availability. The Housing Credit Availability Index (HCAI) assesses lender tolerance for both borrower risk and product risk, calculating the share of owner-occupied purchase loans that are likely to default. Figure 3 shows the trends in the index indicating far less risk in lending in 2017 than in the previous decade.

Figure 3. Housing Credit Availability Index



Source: Urban Institute 2017.

Not all commentators agree that Dodd-Frank requirements are onerous. Lawler (2013) notes that in defining a QM the CFPB did not take into account important variables/factors that impact the probability that a mortgagor will default. In setting the QM definition, the CFPB focused on (1) product features; (2) up-front fees charged; (3) verification of relevant borrower information; and (4) a maximum back end total debt-to-income ratio of 43% (with some exceptions). *"Strikingly QM does not include an LTV requirement. This is despite the fact that the loan-to-value ratio is a key determinant of default".*

The lack of an LTV requirement and the exemption of loans eligible for GSE purchase reflect the politicization of the reform process in the US. Industry participants lobbied aggressively for a weakening of the standards arguing that "too tough" a standard would derail the nascent housing recovery. This pressure can also be seen in the decision by the Federal Reserve to drop a provision on bank capital requirement that required banks to hold higher amounts of capital against riskier loans. Industry revenue and production compensation is driven by volume so participants strongly resist any measures that might reduce the volume of lending[13].

Qualified Residential Mortgage: Dodd-Frank also mandated regulators to create a class of mortgage called the "Qualified Residential Mortgage" (QRM). MBS that are backed by loans that are QRMs are not subject to risk retention (holding 5% of the risk of loans sold), which according to the legislation most other asset-backed securities are subject.

The original proposed definition of a QRM included a hefty (20%) down payment, a debt-to-income ratio no greater than 36%, restrictions on a borrower's credit, and loan features excluded from a QM. Lawler notes that the real estate and mortgage industry lobbied hard against the initial QRM proposal claiming that (1) the "massively inflated costs" to issuers/originators of the risk-retention requirement would be passed on to consumers; (2) many potential borrowers would be excluded from getting mortgage credit; and (3) having a QM definition that differed from a QRM definition would add to the growing regulatory burden being placed on mortgage lenders. They lobbied extremely hard to make the two definitions the same – even though the legislation explicitly differentiated between the two.

In October 2014, federal regulators released a final rule on what loans are exempt from QRM. As expected the QRM is aligned with the definition of QM with no mention of a downpayment or credit score requirement. Loans sold to Fannie Mae and Freddie Mac are exempt from QRM. The original intent of the Dodd-Frank risk retention rule was to make sure that issuers/originators had "skin in the game," which it was hoped would better align the interests of issuers/originators and investors as studies have shown that [a high] loan-to-value is a major factor in mortgage default. Mortgage and real estate industry lobbyists argued that "low-risk" mortgages should be exempt from the risk-retention requirement. Risk retention was a clear intent of legislators in Dodd-Frank, and real estate and

13 Mortgage brokers and retail loan officers are paid almost entirely on commission. They receive a fee, around 1.5% of the loan balance. Thus, they have an incentive to see that the loan is funded and is as large as possible.

mortgage lobbyists have effectively eliminated it for the vast bulk of mortgages that will be originated. Furthermore, exempting GSE mortgages from QRM further entrenches their dominance in the market.

Elimination of the downpayment requirement significantly reduced the impact of Dodd-Frank on mortgage risk. Research by the GAO (2015) showed substantial declines in defaults from reductions in LTV. For fixed rate non-prime purchase loans, moving from an LTV of 100 to under 80% reduced projected default probabilities by over 3 percentage points. For hybrid non-prime ARMs, the reduction in projected default probabilities was just over 6 percentage points. Coupled with full documentation, a DTI cap and an LTV under 80%, one could eliminate over 70% of the default risk among hybrid non-prime ARMs. However, if the downpayment requirement is dropped the combined impact of the DTI cap and full documentation was estimated to lower default rates by only 1 percentage point.

Implementation of the mortgage provisions of Dodd-Frank has increased the cost of originating a mortgage and the time for approval. The Mortgage Bankers Association reported that in the first quarter of 2017, loan production expenses – which include commissions, compensation, occupancy, equipment and corporate allocations – increased to a study high of 8,887 USD (MBA 2017a). For comparison purposes the cost to originate a loan in 2008 was about 5,985 USD. Servicing costs have also increased. The average cost to service a performing loan in 2016 was 163 USD, down from a study high of 185 USD in 2015 (MBA 2007b). In contrast the average cost in 2008 was 59 USD. The average cost of servicing a non-performing loan was 2,113 USD in 2016 up from 482 USD in 2008. Servicing costs are much higher than they were in 2008 as a result of the loan modification requirements and charges due to legal settlements.

Products: As pointed out by Lea (2010) one likely result of the QM rule is to further ensconce the long-term fixed rate mortgage as the dominant instrument in the US. Requiring ARM qualification at the highest possible rate in the first five years takes away its affordability advantage. QM is likely to greatly reduce the incidence of non-traditional "affordability" products such as interest only, balloon and teaser ARMs. Although the product types and features that cannot be included in a qualified mortgage are not banned, many lenders are reluctant to make them due to the lack of a legal safe harbor against borrower lawsuits.

A particularly important aspect of US mortgage market design is the dominance of the long-term fixed rate mortgage (FRM) that can be prepaid without penalty. The FRM is a creation of the government. It is not a naturally occurring instrument in modern financial systems as it creates substantial financial and taxpayer risk.

The FRM was born in the Depression as a solution to the refinancing problems of borrowers with non-amortizing mortgages (deRitis 2013). The FHA insured these instruments and when private lenders refused to make them due to concern over the financial risk, the Federal National Mortgage Association (Fannie Mae) was created to purchase them funded by Treasury debt. The dominance of the instrument was entrenched when savings and loan institutions were required to originate only FRMs in the 1960s and 70s. Dependence on the FRM bankrupted the savings and loan (S&L) industry in the 1980s when the rise in interest rates exposes the mismatch in S&L portfolios. The government continued to support the instrument through the activities of the GSEs whose purchases were predominately FRM. In the current low rate economic environment over 95% of US mortgages are FRMs.

The long-term fixed rate mortgage has undeniable consumer benefit including payment stability and simplicity. The Federal Reserve's efforts to keep interest rates exceptionally low have encouraged millions of borrowers to lock in long-term interest rates, which will insulate them when rates rise in coming years. Increased refinancing activity allowed households to hang on to more of their income rather than spending it on debt service, thereby supporting additional spending and the broader recovery as a consequence.

However, there are significant costs (Lea and Sanders 2011). The interest rate and prepayment risks in the FRM are costly and difficult for investors to manage. A huge volume of derivative instruments is necessary for investors to manage the risks. The premium for the long term and the prepayment option raise rates for all users of the mortgage. The FRM can create negative equity in an environment of falling house prices locking borrowers into above market rate mortgages defeating the purpose of accommodative monetary policy. The FRM requires securitization in order to manage the inherent interest rate and prepayment risks which in turn leads advocates to support government guarantees to ensure its continuation (Min, 2010).

In defense of the FRM supporters point to the protection against interest rate increase and the ability to take advantage of interest rate reductions (the FRM could be likened to a downwardly adjusting ARM). But does the benefit have to extend to thirty years? Prior to the recession the average household moved every five years. The mobility rate has fallen to a record low reflecting stagnant income, rising house prices, negative equity and tighter mortgage underwriting. Borrowers who refinanced post crisis are reluctant to move and give up their low rate non-assumable mortgage. As pointed out by deRitis, a 5:1 ARM gives borrowers a significant amount of payment stability with significant savings due to its lower rate in most economic environments.

Dodd-Frank restricts the use of prepayment penalties. They cannot be used on qualified adjustable rate mortgages. Even when permitted, a prepayment penalty on a qualified mortgage must not apply after the three-year period following origination and must not exceed 2% of the outstanding loan balance prepaid during the first two years or 1% of the outstanding loan balance prepaid during the third year after consummation[14]. In addition, if the creditor offers the consumer a mortgage with a prepayment penalty, it must offer an alternative mortgage without a prepayment penalty that meets certain conditions to qualify as an alternative. Furthermore, many states ban the use of prepayment penalties on FRMs and the GSEs do not enforce prepayment penalties on any FRM. The restrictions on prepayment penalties suggest that it will be difficult to introduce covered bonds into the US market (other than the Danish Principal of Balance version).

It is important to note that most of the product and underwriting restrictions contained in Dodd Frank do not preclude offering of loans with more liberal underwriting, documentation and product features. In fact, lenders currently offer subprime and limited documentation loans[15]. Such loans resemble those made in the 1990s with high downpayment requirements. Lenders are supposed to abide by the ability-to-pay rule but stated income loans are being offered[16]. But the legal risk associated with originating a loan that does not meet the QM safe harbor or rebuttable presumption means that such loans are likely to be made by non-bank lenders.

Until recently, litigation and regulatory exposure for past sins has been a major factor limiting housing credit. Lenders faced uncertainties about GSE repurchase demands and indemnifications requested by FHA, and how agencies interpret loan acceptability. The agencies have forced lenders into huge settlements for alleged bad past lending practices[17].

The combination of litigation, repurchase requirements and higher costs have led to a shift in mortgage origination. Non-bank institutions (finance companies) are now the largest category of mortgage lender accounting for 78% of originations in October 2017 up from 36% in early 2013 (Figure 4). All the major banks except Wells Fargo have retreated from mortgage lending.

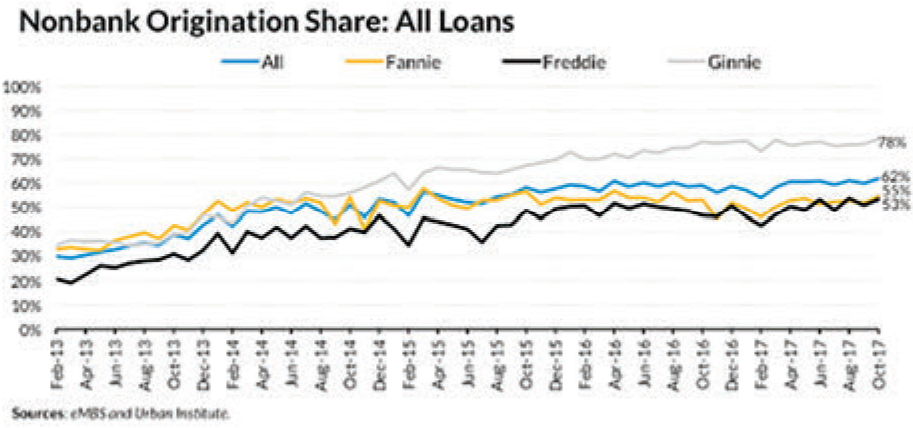
14 If a non-QM loan has a prepayment penalty in excess of these restrictions, it is considered a "high cost" loan exposing the lender to greater regulatory and legal risk.

15 https://www.ft.com/content/3c245dee-8d0f-11e7-a352-e46f43c5825d

16 https://www.blownmortgage.com/subprime/

17 http://www.foxbusiness.com/industries/2013/11/19/jpm-settlement/

Figure 4. Nonbank origination share



Source: Urban Institute 2017.

Incentives: Incentive incompatibility was a major factor in the crisis. Serious incompatibilities existed throughout the mortgage value chain. Mortgage brokers and loan officers were paid almost entirely on commission creating an incentive to close a loan regardless of quality. Appraisers were pressured by lenders to support desired loan amounts with the threat that low valuations would result in less business. Lenders were driven by volume and market share with no regard quality as most mortgages were sold in the secondary market without recourse[18]. Fees and gains on sale reflecting the accounting of future income to create and distribute mortgage-backed securities incented investment banks (Gorton and Metrik, 2012). The rating agencies were (and are) paid by debt issuers. They were incentivized by the volume of ratings and pressured by investors to overstate the quality of the security.

Regulation has done little to change origination incentives. As Dodd-Frank states, “loan originators can continue to receive compensation that is based on a percentage of the loan amount, which is a common practice”. Despite the widespread knowledge that volume-based incentives were a root cause of the crisis, nothing has been done to change the way mortgage originators are compensated. They are paid a commission based on 1) closing of the loan and 2) value of the loan. Thus, there is a great incentive to “do what it takes” to get a loan closed and

[18] Loans are sold in the secondary market with lender representations and warranties that purchase and servicing guidelines of investors were being followed. Subsequent defaults have shown that the reps and warrants were often not followed which has triggered loan repurchase demands from investors.

encourage borrowers to take out larger loans. These incentives have not been addressed in post-crisis regulation[19].

The use of mortgage brokers and intermediaries entails a classic agency problem. Brokers (the agents) get compensated when the loan closes whereas the lender/investor bears the risk and the borrower bears the cost of the originated loan. LeCour-Little found that broker originated loans cost more than those originated through retail channels (LeCour-Little, 2009). The "liar's loan" phenomenon of the last decade is another example of the agency problem. Research by Jaing et. al. (2010) highlights two major agency problems underlying the mortgage crisis: one between the bank and mortgage brokers that results in lower quality broker-originated loans, and the other between banks and borrowers that results in information falsification by borrowers of low-documentation loans known in the industry as "liars' loans"- especially when originated through a broker. They find that broker loans default more often in general and limited documentation loans originated by brokers default more often in particular.

The stringent documentation requirements of Dodd Frank along with the on-going threat of buy-backs has eliminated the low/no document loan from the US mortgage market. This has virtually eliminated the ability to do liars' loans but it has disproportionately impacted self-employed borrowers who have difficult meeting the documentation requirements of lenders.

Another area of abuse in the run up to the crisis was inflated appraisals. Brokers and loan officers were known to pressure appraisers for higher valuations to support larger loan amounts. The regulatory solution was to adopt the Home Valuation Code of Conduct ("HVCC" Freddie Mac 2009). A major aim of the regulations was to ban direct contact between the broker/loan officer and appraiser. Specifically, "lender's loan production staff is prohibited from being involved in the selection of the appraiser, or having any substantive communications with an appraiser or appraisal management company about valuation". In effect, appraisals have to be ordered and reviewed by the credit department of the lender. Furthermore, the appraiser's compensation cannot depend on the final estimate of value or the closing of the loan.

Institutions that deliver loans to Fannie Mae or Freddie Mac must represent and warrant that the appraisals obtained adhere to the requirements found in the HVCC regarding appraisal management, ordering and review by lenders. To comply,

[19] In Australia mortgage brokers can be paid trailing commissions on a declining scale over three years. The commission can be "clawed back" if the loan prepays or defaults in less than a year. In the UK brokers are paid a flat fee independent of the mortgage value.

many lenders have outsourced the appraisal process to Appraisal Management Companies (AMCs) that manage a large network of appraisers. This practice in turn has led to complaints that AMCs use appraisers who are unfamiliar with the neighborhoods in which valuations are requested and has raised appraisal cost.

A consistent complaint about appraisals in the aftermath of the crisis is a downward bias in valuation that makes borrower qualification more difficult. In part this reflected the influence of distressed sales on the market. Research published in 2015 suggest that the HVCC has led to a reduction in the probability of inflated valuations, and induced a significant increase in the incidence of low appraisals (Ding and Nakamura, 2015). The well-intentioned HVCC rule made it more difficult to obtain mortgages to purchase homes during the housing price crash, possibly exacerbating the fall in prices.

Often in distressed areas such sales make up the majority of transactions available as comparables. To date there has been no discussion of moving to a mortgage lending value concept similar to that used in collateral valuation for German Pfandbrief lenders[20].

The securitization process creates a number of incentive incompatibilities (BIS 2011). Originators and sponsors had significant revenue incentives to expand volume. This included fees for originating the underlying assets, underwriting and structuring the transaction, and providing credit and liquidity enhancements for certain structures. Issuers also created revenue streams through credit arbitrage vehicles that took advantage of the spread differential between longer-term assets and shorter dated liabilities issued to finance their purchase (i.e., structured investment vehicles). Accounting rules that allowed the recognition of 'gain on sale' at initiation of a securitization also encouraged issuance (see below).

The BIS highlighted the compensation issue in securitization as well. "*Compensation programs typically emphasized volume and growth, overshadowed concerns about the quality of underlying assets. Volume-based compensation at origination for the broker or loan officer and income booked at securitization execution for the sponsor did not tie long-term performance or quality of underwriting to compensation. The emphasis on volumes and short-term gains extended throughout originator/sponsor organizations, from trading desks up to executive leadership. As a result, an increasing amount of poorly underwritten loans came to be securitized*" (p.14).

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[20] Mortgage lending value "the value of the property which based on experience may throughout the life of the lending be expected to be generated in the event of sale, unattached by temporary, e.g., economically induced, fluctuations in value on the relevant property market and excluding speculative elements." In other words, it is a value based on the concept of a long-term loan designed to smooth valuations over the cycle. Quentin [2009].

The crisis exposed another long-standing incentive problem in the US financial markets. The rating agencies were key players in the development and proliferation of private label securities. There ratings were key to the issuance of securities and investors depending on ratings often in lieu of their own due diligence. Rating agencies have a fundamental conflict of interest as issuers, as opposed to investors, pay them. Like mortgage originators they were incentivized by volume and received fees for rating thousands of mortgage-backed securities. They were subject to pressure from issuers to increase the size of highly rated tranches so as to reduce the necessary credit enhancement provided.

Rating agency incentive conflicts increased with their securitization business. Issuers figured out how to game the rating agency criteria. Flawed methodologies and data inputs were often used to assign ratings, and the investors who relied on them did not always have access to sufficient information to question and assess them. The methodologies and inputs used to rate nonprime residential MBS (and CDOs backed by MBS) were particularly flawed, overestimating the quality of the underlying loans and underestimating the correlation of their performance. As a result, most of the senior tranches of such products have been downgraded (IMF 2009).

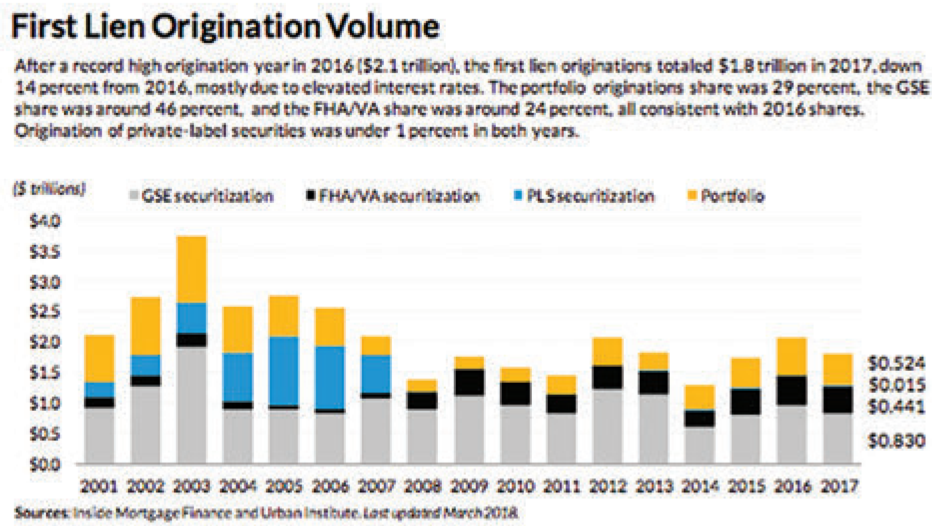
Dodd-Frank mandated several rating agency reforms (Rivlin and Soroushian, 2017). The Act required the Securities and Exchange Commission (SEC) to study the issuer-pays model and alternatives to it and recommend a business model for the rating agencies. The SEC held meetings to discuss different models' strengths and weaknesses but did not endorsed a business model or implement a random assignment of rating agencies. Dodd-Frank required regulators to remove and replace the use of credit ratings in regulations that set capital requirements and asset holdings for financial institutions. The ratings have been replaced by financial analysis of issuers, a formula for setting risk weights for structured products and use of designating non-agency third parties when setting capital requirements. Dodd-Frank required the SEC to create rules for internal controls, conflicts of interest for credit analysts, standards for credit analysts, transparency and ratings performance statistics. The SEC has finalized these rules.

Over the years, lawmakers have tried to open up the oligopolistic world of ratings agencies to greater competition and, therefore, better performance. Legislation in 2006 encouraged the SEC to let new companies into the ratings club. The commission set up the Office of Credit Ratings to register new entrants and to monitor all participants' activities. Today, the SEC recognizes ten credit ratings agencies but the market is still dominated by the Big 3. Gaining regulatory approval to join the ratings arena is exceedingly burdensome (Morgenson 2013).

GSE Reform: The two largest government sponsored enterprises, Fannie Mae and Freddie Mac, were put into conservatorship in September 2008[21]. Since then more than fifty bills have been proposed to address various aspects of the GSE ranging from liquidation to switching GSE pay to government rates. Notably none have passed or even been voted upon.

As shown in Figure 5, the government share of mortgage originations (Fannie Mae, Freddie Mac and FHA/VA securitization) swelled to 83% in 2013, up from less than 40% in 2005–06. Since that peak, the government share has stabilized around 70%.

Figure 5. Share of new originations



Source: Urban Institute 2018.

Since they were taken into conservatorship there has been considerable debate about the future of the enterprises. The US Department of the Treasury issued a white paper in 2011 outlining three options for the future of the GSEs (US Treasury, 2011).

[21] Conservatorship involved the government taking over Fannie Mae and Freddie Mac and appointing the regulator, the Federal Housing Finance Agency, as conservator. As defined by the FHFA "the purpose of appointing the Conservator is to preserve and conserve the Company's assets and property and to put the Company in a sound and solvent condition. The goals of the conservatorship are to help restore confidence in the Company, enhance its capacity to fulfill its mission, and mitigate the systemic risk that has contributed directly to the instability in the current market. The FHFA, as Conservator, may take all actions necessary and appropriate to (1) put the Company in a sound and solvent condition and (2) carry on the Company's business and preserve and conserve the assets and property of the Company". See www.fhfa.gov

- Option #1: Privatized housing finance system with limited FHA/VA/USDA role for targeted assistance;
- Option #2: Private markets + government guarantor of last resort. The guarantee would be priced out of the market during normal times;
- Option#3: Broad-based private mortgage guarantees with explicit, priced government reinsurance of MBS issued by private, regulated mortgage guarantors. The government reinsurance would kick in only if private guarantors fail. In effect the government guarantees most mortgages with private capital taking first loss.

Defenders of the GSEs point to the need for reform to do the following (Min 2010):

- Keep housing finance affordable as they fear rates will rise significantly without the guarantee and liquidity provided by the GSE;
- Keep the 30-year fixed rate mortgage pointing to the necessity of removing credit risk in order to induce investors to take the interest rate and prepayment risk;
- Supply sufficient funds to the 10 USD trillion residential mortgage market which is too large to be funded by the banking system;
- Ensure market stability by maintaining a constant presence which they believe private capital will not do;
- Maintain the TBA (To Be Announced) market which allows lenders to hedge loan commitment risk[22].

Critics of the GSEs make the following points (Lea and Sanders 2012, Jaffee 2012):

- The private sector is capable of providing sufficient mortgage credit at market prices – international experience supports this assumption;
- The 30-year fixed rate mortgage would continue to exist but with a smaller market share due to higher rates without a guarantee. Jumbo fixed rate mortgages were originated prior to the crisis and currently;
- Securitization can be done by the private market; the private label securities market thrived for more than a decade before it was undermined by poor quality collateral and can be revived with appropriate regulation and transparency;
- The taxpayer should not be on the hook to support companies; if guarantees are to be offered they should be on the security not the issuer;

[22] To be announced (TBA) is a phrase used to describe forward-settling mortgage-backed securities (MBS) trades. Pass-through securities issued by Freddie Mac, Fannie Mae and Ginnie Mae trade in the TBA market, and the term TBA is derived from the fact that the actual mortgage-backed security that will be delivered to fulfill a TBA trade is not designated at the time the trade is made. Investopedia [2018].

- The government has other tools to stabilize the market for example through Fed purchases of mortgage securities or extension of Ginnie Mae guarantees; and
- It is very difficult to keep politics out of housing finance if the government is providing taxpayer guarantees.

Many commentators are sanguine about the prospects for passage of meaningful reform of the GSEs. As noted by Ellen Seidman, a senior fellow at the Urban Institute and former financial regulator *"You've got an ideological right that wants no government guarantee at all, except grudgingly through the Federal Housing Administration"*, she says. *"And you have sort of everybody else wanting some sort of guarantee"* (DePillis, 2013). The reality is that reform of entities with over 5 USD trillion in assets and guarantees that fund 70% of the mortgage market is complex and controversial. For many the status quo is preferable to an unknown future without the GSEs and their guarantees.

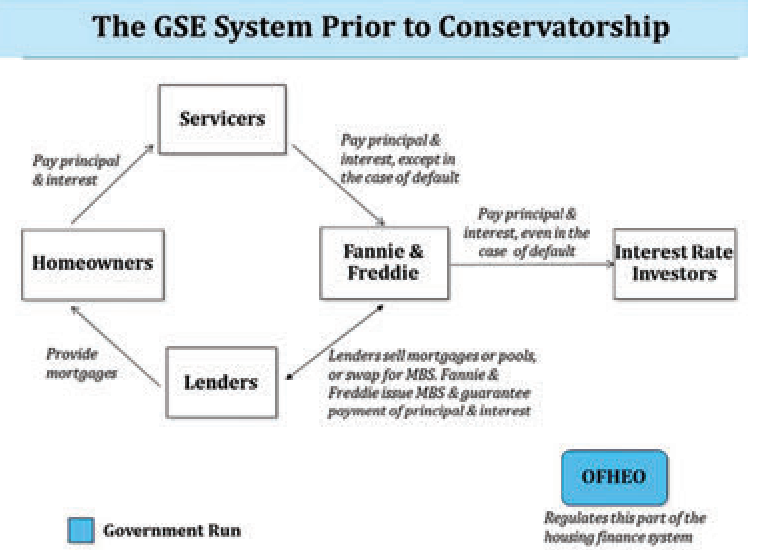
In the meantime, the FHFA has taken steps to reduce the GSE presence in the market (FHFA, 2012). They have imposed higher guarantee fees (more than doubled since crisis) to restore profitability and reduce the spread between GSE and non-GSE funded mortgages. They reduced loan limits and shrank the size of the GSE investment portfolios. FHFA has started a project to consolidate the GSE securitization platforms (the Common Securitization Platform) to create greater standardization and liquidity in GSE securities.

FHFA has been encouraging the Enterprises to use credit risk transfer (CRT) transactions to reduce the taxpayer risk. With these transactions, the GSEs transfer some of the credit risk they have assumed on a pool of mortgages to a capital markets investor – typically asset managers or hedge funds – or to a reinsurance company. The GSEs collect their normal guarantee fees from lenders for covering the entirety of the credit risk, but they pay investors and reinsurers for shouldering some of that risk. (Goodman, Parrott and Zandi, 2015). In 2017, FHFA required the GSEs to lay off credit risk on 90% of newly acquired loans in categories targeted for transfer. Fannie Mae's CRT issuances to date cover 34% of its outstanding guarantees, while Freddie's covers 48%.

The Trump administration has announced its intent to pursue GSE reform. In Congressional testimony on January 30, 2018, Secretary of the Treasury, Steven Mnuchin *"(…) reaffirmed his commitment to restructuring the nation's housing-finance system and solving the Fannie Mae/Freddie Mac problem. In testimony before the Senate banking committee, Mnuchin said he backs survival of the 30-year fixed-rate mortgage, adding that the conservatorship status of the GSEs is not a "sustainable or lasting solution. The Senate Banking Committee Chairman Sen. Mike Crapo said housing finance reform is currently his highest priority on the committee and he wants* *to explore what steps can be taken to ensure there's more private capital in the system. Mnuchin agreed that in order to protect taxpayers there has to be substantial private capital at risk in front of any government guarantee"* (Inside Mortgage Finance 2018).

A recent Urban Institute publication (Parrott, 2017) analyzed current proposals for reform. Figure 6 shows how the GSE system looked before conservatorship.

Figure 6. The GSE system prior to conservatorship



Source: Parrott 2017.

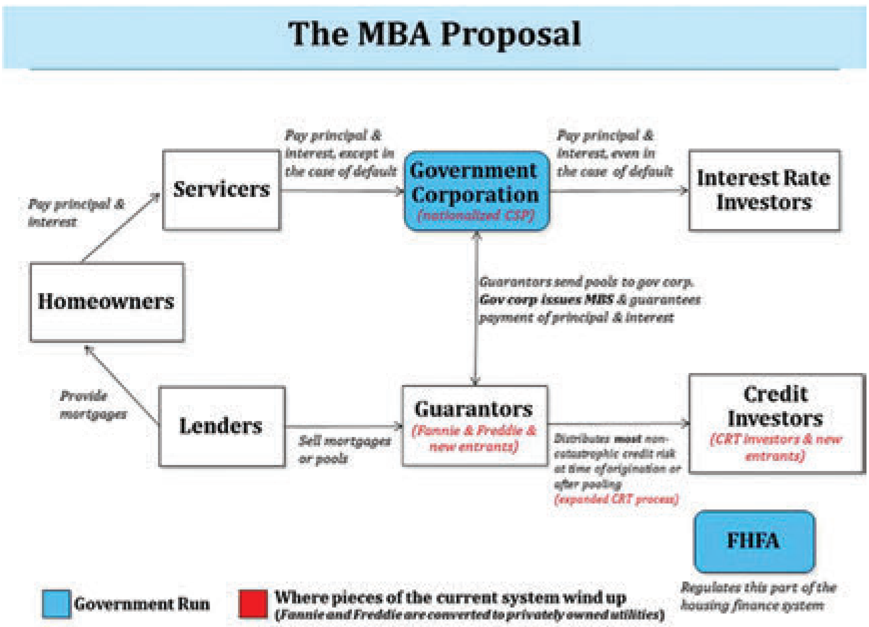
The problem with this system was its dependence on a privately owned duopoly. Fannie and Freddie handled almost all of the securitization in their segment of the market and took almost all of its credit risk. Given their importance, everyone in the market knew that the government would bail them out if they ever stumbled[23]. Their shareholders were thus incentivized to take excessive risk to chase greater profits, knowing if their bets did not pay off the taxpayer would step in to cover the losses.

The proposal that is generating the most interest is one put forth by the Mortgage Bankers Association. The MBA proposal is shown in Figure 7. It turns the GSEs into privately owned utilities with regulated rates of return and opening them up to competition from newly chartered guarantors. And it turns the Common Securitization Platform into a government corporation that issues the securities

[23] The security prospectuses of the GSEs state that the government does not back them. Despite that statement their debt traded at spreads only slightly above comparable maturity Treasury bonds.

of Fannie, Freddie, and any other chartered guarantors and guarantees the interest rate investors the timely payment of principal and interest on their investments. An alternative proposal being advanced in the Senate would expand the mission of Ginnie Mae to guarantee timely payment of securities issued by the private guarantors that would bear and charge for non-catastrophic credit risk.

Figure 7. The MBA proposal



Source: Parrott 2017.

Government Housing Policy: Despite the difficulties created by the meltdown of the mortgage market, the federal and state governments remain committed to a strong homeownership policy. The mortgage interest tax deduction (MID) remains in place although the cap was reduced from a 1 million USD mortgage to 750,000 USD (both primary residence and a second home).

Despite their role in the crisis, the GSEs are still subject to housing goals. The goals have been modified and scaled back somewhat but enterprise performance is still tracked annually. The goals for 2015–2017 are shown in Box 1 including the market percentages of each category[24]. The goals for low-income purchase and

[24] (1) **A low-income (LI) home purchase (HP) goal,** for families purchasing homes with incomes no greater than 80% of Area Median Income (AMI); (2) A **very low-income (VLI) home purchase goal,**

refinance were raised slightly and the goal for very low-income home purchase was reduced. There are also goals for low and very low-income multifamily rental units (300,000 and 60,000 units financed respectively).

Box 1. GSE housing goals

Goal Category	Benchmark Level
Low income home purchase	24%
Very low-income home purchase	7%
Low income area home purchase	14%
Low income refinance	21%

Source: FHFA.

The government mortgage insurance programs, FHA and VA, remain a major component of the mortgage market as providers of low downpayment mortgages. FHA's market share has been around 20% since the onset of the crisis. The FHA insures mortgages with loan-to-value ratios as high as 96.5%. The VA (Veteran's Administration) insures mortgages up to 100% LTV. The average LTV on new FHA endorsements is 96% for purchase transactions and 79 to 86% for refinanced loans each year since 2010 (HUD 2017). In 2016 and early 2017 the average FICO score was 680. The FHA lowered its loan limits at the end of 2013 from a 729,750 USD to 625,500 USD.

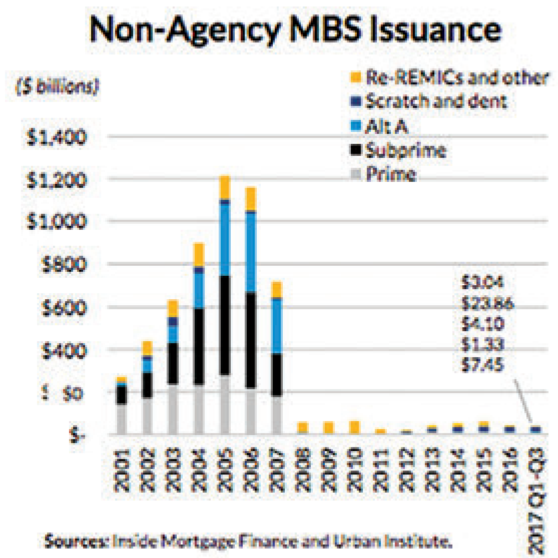
Securitization: Private label mortgage securities (PLS) have been issued without guarantees since the 1980s. They reached a peak of 2.9 trillion USD outstanding in 2007 with more than 11.5 million mortgage loans backing private RMBS, accounting for more than one-fifth of total mortgage debt outstanding (Zandi 2013). The outstanding balance of non-agency securities has fallen to less than 500 billion USD due to a virtual cessation of new issuance and defaults, amortization and prepayments affecting existing issues (Figure 8). PLS fund jumbo prime loans as well sub-prime and Alt A loans, non-performing and re-performing loans.

PLS issues prior to the crisis suffered from a number of structural flaws and incentive problems. In particular they were characterized by a lack of transparency and standardization, poor underwriting standards, numerous conflicts-of-interest

for families purchasing homes with incomes no greater than 50% of AMI; (3) A **low-income areas (LIA) home purchase subgoal**, for families purchasing homes in (a) low-income census tracts, with median income no greater than 80% of AMI, and (b) high-minority tracts, with minority population of at least 30% **and** tract median income less than 100% of AMI **if** borrower income does not exceed 100% of AMI. The goals are not exclusive.

between servicers and investors, antiquated and defective mortgage servicing practices and an absence of effective legal remedies to investors for violations of MBS contractual obligations. For decades PLS investors had relied on issuers, underwriters, due diligence firms, and ratings agencies to judge the quality of the securities they were considering; and, they had relied on trustees, servicers and attorneys to protect their rights once they had invested. Yet, when a rise in defaults began to put pressure on the system, every one of these relationships failed under the strain (Parrott 2016).

Figure 8. Non-agency securitization issuance



Source: Urban Institute 2017.

On the surface, the market prospects for a revival of PLS appear bright. The loans being originated today are of pristine quality with high FICO scores, low LTV and full documentation. Sustained house price increases further reduce risk on existing loans. Almost all mortgages are long term FRMs with no exotic features that could induce future default. Although the government still dominates the mortgage market, it has been slowly pulling back on its support. The GSEs have more than doubled guarantee fees improving the competitiveness of private label securitization. Moody's estimates that private label securitized mortgages would become competitive with GSE eligible loans with another 20-basis point increase in fees. Basel III treatment of Mortgage Servicing Rights has raised the cost of servicing mortgages[25]. The risk of put backs and a shift in the regulatory environment from risk management to a zero tolerance and 100% compliance regime have dampened bank appetite for mortgage loans leaving room for non-bank competitors.

However, the economics for PLS have not been favorable. PLS issuers can't compete with government-backed issuance because agency MBS investors are able to get a better yield relative to the range of risks involved. And PLS issuers can't compete with portfolio lenders because the banks have a lower cost of funds and better capital treatment. Although there has been some progress on standardization and transparency in PLS transactions the lack thereof is still an obstacle to growing the market.

There is also significant legal and regulatory uncertainty retarding PLS development. A major obstacle is the lack of clarity on QRM and the risk retention requirements of securitized mortgages. As pointed out by Whalen (2013) the reality of the Dodd-Frank law is that the "skin-in-the-game," risk retention provisions arguably make it impossible for new, privately backed mortgage securities to qualify as "true sales" under US accounting rules. As of mid-2017 the SEC had not opined on what constitutes true sale.

Although risk retention may not be required for the majority of US mortgage loans (QM) the reality is that issuers have risk through the representations and warranties they provide upon sale. Through the "reps and warrants" sellers attest that they followed investor sale and servicing guidelines. If a loan goes into default and the seller servicer is found to have violated reps and warrants, it can be required to repurchase the mortgages. Prior to the crisis the repurchase risk was viewed as diminimus. Fannie Mae and Freddie Mac issued repurchase requests for nearly 100 billion USD as of mid-2013 putting a damper on the attractiveness of mortgages for banks (Jones and Price, 2013). With the advent of QM repurchase requests have become insignificant.

Leverage: There has been progress on rebuilding banking system progress on capital and write-downs of non-performing loans. The Capital Purchase Program (CPP) was successful in boosting recipient banks' regulatory capital ratios and stimulating bad loan write-offs (Montgomery and Takahashi 2012). But Fannie Mae and Freddie Mac have not been recapitalized as all of their profits flow to the US Treasury, repaying the government for its past support. Regulators and policy

[25] Mortgage servicing rights (MSR) are created when a lender sells a loan and retains the right to service (for a fee). MSRs are limited in Basel III to 10 percent of bank Tier 1 capital. Large lenders with significant MSR exposure have been selling MSRs in anticipation of this regulation.

makers have not proposed concrete capital levels for the GSEs in the event they are retained in a corporate form. The FHA was de-capitalized by losses suffered during the crisis but its net worth has risen from negative 1.3 billion USD to a positive 32 billion USD in 2016 (HUD 2016). Increased insurance premiums, tighter underwriting and restructuring of its troubled reverse mortgage program along with rising house prices have eliminated the capital deficit. The capital ratio for the main FHA insurance fund was 2.32% at the end of 2016.

Foreclosure Prevention: In response to the crisis the US adopted a number of programs to reduce the incidence of mortgage foreclosure. These include loan modification (the largest program), foreclosure moratoria, refinance and laws passed to slow the foreclosure process. Clearance of past delinquencies, house price increase and employment growth have led to serious delinquency rates (ninety days delinquent or in foreclosure) to levels of 2007. Loan modification programs are winding down. The government estimates that over eight million households have received assistance (Urban Institute, 2017).

Although many households may have been saved from foreclosure (either temporarily or permanently) government actions may have undermined the effectiveness of collateral in housing lending. Various moratoria, settlements with lenders over abusive foreclosure practices and state and local legislation considerably slowed the foreclosure process – in some cases to more than two years. In effect, borrowers can remain in their house without making mortgage and often property tax payments. This can incentivize borrowers to default and reduces the deterrent effect of foreclosure and repossession. Many states in the US do not allow deficiency judgments. Research by Ghent and Kudlyak (2009) found that recourse decreases the probability of default on loans with negative equity.

Fraud: Mortgage fraud was a significant part of the US mortgage market in the 2004–2006 time period. According to Core Logic (2013) in 2007 the industry faced nearly 100 million USD fraudulent loan originations from "shot-gunning" where fraudsters would simultaneously close multiple loan applications on the same property with different lenders. The incidence of fraud has declined significantly but remains a problem. Corelogic (2017) reported that during the second quarter of 2017, an estimated 13,404 mortgage applications or 0.82% of all mortgage applications contained fraud. Common sources of fraud include occupancy, income, property misrepresentation, undisclosed debt, identity theft and multiple closing on the same property.

Conclusions: what has changed?

Although debate rages about the relative importance of each there were a number of factors underlying the mortgage meltdown of 2008–2009. Low interest rates, a house price bubble, government housing policy, excessive leverage, agency problems caused by perverse incentives, risky products, lax underwriting and fraud just to name a few. Government policy in the US has sought to address these problems in the years following. Yet for all the debate, legislation and regulatory action remarkably little has changed in the US housing finance system. The reason is the numerous legislative and regulatory actions have focused on the symptoms of the crisis rather than the underlying causes.

The main focus of US housing finance policy has been to tighten underwriting and restrict product availability. The focal point of Dodd Frank is the Qualified Mortgage, an attempt to create a very safe mortgage that becomes the industry standard. Although Dodd Frank does not mandate this mortgage the incentives it creates for lenders virtually ensures it will be the dominant instrument. Creating a safe mortgage does not address the incentives and policies that led to the crisis. The US housing finance system remains one in which government policy is focused on expanding homeownership and stimulating the housing market and the industry is focused on maximizing volume and shifting risk.

Even the Dodd Frank attempt to reduce risk in the mortgage market was watered down in the name of retaining access to credit and supporting the housing market. The intent of Dodd Frank was to ensure that all market participants have "skin in the game" to align incentives throughout the mortgage value chain. For borrowers this means a meaningful downpayment. However, a downpayment requirement was dropped from the QM definition.

In defining QM without a downpayment requirement, the CFPB ignored the most important determinant of default – borrower equity. The risk retention elements of Dodd Frank were undermined as a result of heavy industry lobbying. The Realtors, homebuilders, mortgage bankers and housing groups all argued that imposing a downpayment requirement would reduce access to the mortgage market, in particular by moderate income and younger households, and derail the nascent housing market recovery. In addition, they argued it would impose a costly burden on the industry that would be passed on to consumers.

Risk retention was also dropped for the Qualified Residential Mortgage, as its definition is the same as QM, undermining the legislative intent to align incentives between issuers, originators and investors thereby encouraging better origination and servicing.

Low downpayment mortgages continue to be the hallmark of government housing finance policy. The median LTV for purchase loans was 87.6% in 2017, reflecting a high percentage of FHA and VA loans. The FHA and VA insure mortgages up to 96.5 and 100% respectively[26].

Government-backed institutions have long dominated the US housing finance system. Since losing market share in the middle of the last decade, government backing of US home mortgages rose to more than 90% before declining to a pre-crisis level of 70%. Both FHA and GSE loan limits were increased during the crisis and remained as high as 636,150 USD in high cost areas in 2017 despite the fact that their mission is to support homeownership for first time and moderate-income buyers. The industry continues to support retaining the high limits. While most policy makers and politicians state that they want a substantial reduction in the government role, the powerful housing/mortgage lobby strongly resists changes to the status quo arguing that the housing market is too important to leave to the private sector and/or that any changes will endanger the housing recovery.

The GSE regulator has taken seriously its mandate to conserve assets and improve enterprise risk management. Increases in GSE guarantee fees have restored Fannie Mae and Freddie Mac to profitability and contributed to a reduction in their market share. Critics argue that the fees are excessive considering current purchases are very low risk but the fact remains that the GSEs are still under-capitalized and pose a future risk to the taxpayer. The Director of FHFA has said that the GSE's will work to increase the availability of credit going forward – resuming their pre-crisis role in the market.

Advocates for a strong role for the government point to the necessity to maintain the thirty-year fixed rate mortgage and provide guarantees to ensure its survival. The Dodd-Frank Financial Reform legislation stipulates the characteristics of qualified mortgages, which are likely to be the standard instruments in the market going forward. The bill bans or restricts the use of (for QM purposes) pre-payment penalties, balloon payments, interest-only payments and other features commonly offered in the mortgage choice set. It requires ARM borrowers to be qualified at the highest rate in the first five years. By providing a safe harbor against consumer lawsuits the QM de facto becomes the mortgage of choice. A likely outcome of

[26] The GSEs are limited to a maximum 80% LTV unless there is private mortgage insurance. In 2016, 25% of GSE loans had PMI insurance (Urban Institute 2017b).

the bill is to perpetuate the use of the long-term fixed rate pre-payable mortgage (FRM) and solidify government secondary mortgage market support.

Many commentators have pointed to the role of housing goals in the crisis. Surprisingly (or perhaps not given the politics) these goals remain in place for the GSEs. Various proposals to restructure the GSEs contain a provision for a fee charged by the new guarantee agency to fund and affordable housing program.

The major areas of change have been in mortgage underwriting and product offering. The mortgage regulation pendulum has swung sharply in favor of restricting credit. Sub-prime and Alt A mortgages almost disappeared and documentation requirements became extraordinarily tight (i.e., the concept of compensating factors has disappeared – the documentation requirements and underwriting guidelines must be adhered to the letter). In addition to QM, a major factor driving the tightening of credit was the repurchase requirements of the GSEs. Lenders lived in fear of having to repurchase loans and go to great efforts to ensure that they cannot be tripped up by technicalities. Although the repurchase demands of the GSEs have abated their memory will last.

The exotic affordability products of the last decade also largely disappeared. In part this is due to the fact that affordability has improved markedly due to low interest rates and falling house prices. With house prices on the rebound and interest rates on the rise we are beginning to see some of the affordability products offering lower start rates remerge.

Perhaps not surprisingly, underwriting is being loosened and affordability products are reappearing. The GSEs have increased the maximum debt-to-income ratio on loans they will purchase to 50% (they are exempt from QM). Using data spanning nearly a decade and a half, Fannie's researchers analyzed borrowers with DTIs in the 45% to 50% range and found that a significant number of them actually have good credit and are not prone to default (Harney 2017). Interest only loans are widely available (held in bank portfolios) and stated income loans are being offered.

A major change coming to the US mortgage market is likely to exacerbate these trends. The Federal Reserve has ended its QE program and has begun a process of raising interest rates. Short-term rates were increased several times in 2017 and the ten-year Treasury rate (to which FRMs are benchmarked) has risen to 2.7%. In a roughly two-year span that ended in 2014, the Fed increased its MBS holdings by about 1 trillion USD, which it maintained by reinvesting its maturing debt. Since then, 30-year bonds backed by Fannie Mae mortgages have only been about a percentage point higher than the average yield for 5- and 10-year Treasuries (McCormick and Scully 2017). That's less than the spread during housing boom in 2005 and 2006. The 30-year FRM is now (January 2018) at 4.36% – a 164 basis point spread to the 10 year. The move to unwind QE has the potential to cause further mortgage rate increases. Morgan Stanley estimates that a 325 billion USD reduction in the Fed's MBS holdings from April 2018 through end of 2019 may have the same impact as nearly two additional rate increases.

While tightening of mortgage underwriting (and in particular full documentation) was merited the underlying incentives that contributed to the meltdown have in large part not been addressed. The US housing finance system is still a volume driven industry with brokers, lenders and other market participants incentivized to create and sell loans in order to survive. The collapse of the refinance market with rising interest rates is providing a test of the resiliencies of the changes. The decline in volume is putting pressure on lender credit departments to relax the rules so mortgages can be originated. Non-bank lenders are offering subprime and limited documentation mortgages, albeit in small quantities, but funding is available and mortgage rates are rising providing the incentive to expand.

Despite all the problems in the US housing finance system and the multitude of legislative and regulatory changes over the decade, remarkably little has changed. The political allure for supporting housing and homeownership remains strong and the incentives of lenders to maximize volume and market share continue to exist. As such, the seeds for a repeat of a mortgage crisis continue to lie in the ground. Only time will tell whether they will sprout.

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Chapter 10

Households' housing expenditure in Austria, Germany and Italy [originally published in Monetary Policy and the Economy Q4/17]

Christian Beer, Karin Wagner[1]

Housing is human's basic need. Individuals depend on housing more than they depend on many other consumption goods. For most households, housing accounts for the biggest share of total monthly expenditures. Tenants need to pay rent. Homeowners are often indebted due to a high initial payment, and must repay their outstanding loans plus accrued interest. To determine just how much of household budgets goes toward housing in Austria, Germany and Italy, we have used national data from the Eurosystem Household Finance and Consumption Survey 2014 (Albacete at. al., 2016; Banca d'Italia, 2015; ECB, 2016; PHF Survey Team, 2017) to calculate households' housing expenditure (the ratio of housing expenses to household net income)[2].

This paper is structured as follows: Section 1 provides an overview of our data sources and a definition of the term "housing expenditure" as used in this study. In section 2 we discuss some features of the national housing markets. We present the results of our analyses in section 3 and a summary and conclusions in section 4.

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2 A similar exercise was done for Austria in past years (Beer and Wagner, 2012; Wagner, 2011).

1. Data sources and definition of housing expenditure

Housing expenditure is defined as the share of housing-related expenditures as a percentage of household net income. Thus, we are applying an expenditure approach. This approach is often used because of its simplicity and low computational requirements and because the results can be easily understood and interpreted. Drawback of this approach is the fact that it uses only a single measure and that it is highly sensitive to the definition and measurement of housing expenses and household income. Residual income approach is an alternative to the expenditure approach (Stone et al., 2011). The residual income approach requires commonly agreed reference budgets or poverty indicators for housing and non-housing expenditures. As a third option, the expenditure of owner-occupied housing services can be measured by the user cost of housing, which depends on house prices, the preferential tax treatment of home ownership, credit availability, current and expected transaction costs, and the role that ownership plays as insurance against rental price risk (Diaz and Luengo-Prado, 2011). However, the user cost concept seeks to provide a measure of the real cost of owning a home and emphasizes the investment component of home ownership, which is not the aim of this study.

We take into account only those expenditures that are related to the primary residence. We apply a broad definition of housing expenses that includes not only rent and loan-related expenditures (principal repayment and loan interest payments) but also expenditures for mandatory services and charges, maintenance, repairs, taxes and utilities. However, we do not focus on some items that represent costs. For example, we do not include owners'[3] foregone interest income (i.e., the income that owners could have earned from investment/saving alternatives if they had not used their capital to acquire the primary residence). At the same time, we do include repayment of the loan principal in our measure of the housing expenditure even though it represents savings rather than costs or expenditures. As a consequence, institutional differences in mortgage financing could affect our results. We do not include in our calculations owner-occupiers' gains or losses from changes in property valuation. Similarly, we do not count imputed rent as part of household income. We made these choices because our aim is not to calculate housing costs but rather to calculate the expenditures of households for housing purposes. For this reason, we use the term "housing expenditure" instead of "housing cost."

[3] Unless otherwise noted, the term "owner" refers to ownership of the primary residence and not to ownership of other property.

Furthermore, we only take into consideration households' current housing expenditures. Owners have several expenditures when buying a property (e.g., for lawyers, notaries, taxes, obtaining a loan). Thus, owners who had initially taken out a loan to acquire their primary residence but who have since paid back the loan may have had relatively high housing expenditures in the past but their current housing expenditures are relatively low. While owner-occupiers often incur relatively high expenditures at the beginning of their ownership and lower expenditures later, tenants' housing expenditures are more constant. Thus, a study of housing expenditures over the life cycle could potentially lead to different conclusions about the relative housing expenditure of owners and tenants compared to the conclusions about the current housing expenditure presented in this article.

This study uses national data from Austria, Germany and Italy from the second wave of the HFCS. Therefore, our analysis reflects the situation in the year 2014. The rationale for selecting these three countries is that data are available on both household net income and current housing expenditures, including operating expenses. Comparing monthly housing expenditures to monthly household net income (that is, disposable income), is more meaningful than comparing them to gross income. In addition, we see some similarities such as the rates of home ownership in Austria and Germany and attitudes about financing a home with a mortgage. It also seems interesting to consider Italy since the country was more deeply affected by the financial crisis in many respects than the other two countries.

For tenants, monthly rent is the main component of housing expenditures. Owners with outstanding loans taken out to acquire the primary residence have regular loan-related payments (principal and interest). For both tenants and homeowners, operating expenses are factored in as housing expenditures. Operating costs might include, among other things, expenditures on water and sewage, garbage collection, pest control, chimney sweep, premiums for building insurance, taxes and other public charges. In addition, tenants and owners who live in a multi-unit structure might pay for clearing of unclaimed property, electricity for lighting common areas, management fees, house cleaning, and ongoing operating costs of community facilities. However, operating costs are not strictly defined and the definition may vary across surveys. Households might also consider different items when asked about operating costs[4]. That limits the comparability of operating

[4] Data from the 2010 HFCS for Austria show that, among tenants, 8% of households included furniture as operating costs, 11% other inventory such as a washing machine or refrigerator, and 37% garage or parking lot fees. Although these items are housing expenditures, they are not part of operating costs. In addition, 90% of tenant households included water and sewage costs, 61% included heating and 26% included electricity. And though these items are necessities, their inclusion by some households but

costs and the housing expenditure across countries. Nevertheless, our results do provide insights about housing expenditures because operating expenses make up only a relatively small part of total housing expenditures. Finally, our data on housing expenditures include not only energy but also telecommunication expenditures, for the simple reason that the HFCS question on operating costs subsumes telecommunication expenditures under operating expenditures in general rather than asking respondents to provide a detailed breakdown of their expenses[5].

Owners also face maintenance costs. Various international organizations recommend taking maintenance costs into account when calculating housing expenditures (International Labour Organization, 2004; Canberra Group, 2011; Organization for Economic Cooperation and Development, 2013). Expenses for maintenance occur both regularly and, for larger maintenance items, at irregular intervals. The timing of households' payments for maintenance expenses and the maintenance expenses themselves is not necessarily the same. For example, co-owners may make regular payments for potential future maintenance expenses. Under our approach, these regular payments are regarded as housing expenses. Since the surveys do not include questions on comprehensive maintenance costs, we estimate maintenance expenditures by assuming a cost of 1 EUR per square meter per month. This choice is of course disputable but can be justified on the basis of data on extraordinary maintenance expenses in the Italian Survey on Household Income and Wealth (SHIW). Using SHIW data, D'Ambrosio and Gigliarano (2007) calculate maintenance expenses of 0.88 EUR per square meter per month by dividing the annual amount of extraordinary expenses reported by all owners by the total number of square meters of all owners. For the 2014 data, the corresponding figure is 0.92 EUR. However, we should note that "extraordinary maintenance" in the Italian survey includes extensions but not regular maintenance expenses[6].

not others are problematic because it indicates a clear inconsistency in how the question was answered. Respondents' decision whether to include heating costs as operating costs probably depends on the heating system.

5 A core question in the 2014 HFCS questionnaire is: "About how much does your household spend on utilities (electricity, water, gas, telephone, internet and television) in a typical month?" See annex for country-specific survey details.

6 A different approach would be to figure maintenance expenditure based on property value. A major drawback of this approach is that maintenance expenses would change as property prices change. Also, maintenance expenses usually increase as buildings age. Although we have information on the year of construction, we do not have information on major refurbishments or renovations, which is important for assessing the effective age of a building.

2. Comparison of tenure status and features of the national housing markets

Whether households own their primary residence, rent it or are able to use it free of charge has a major impact on current housing expenditures. As a result, the share of owners and tenants has a significant influence on average housing expenditures in a country. In this section we therefore discuss ownership and tenancy rates in Austria, Germany and Italy and describe some features of their housing markets that might explain the differences across countries.

Table 1

Tenure status (%)						
	AT		DE		IT	
Owners	47.7	(0.5)	44.6	(0.2)	68.2	(0.7)
of which with outstanding loans	*27.6*	*(0.4)*	*30.4*	*(1.5)*	*12.2*	*0.6)*
Tenants	45.4	(0.0)	50.9	(0.5)	20.7	(0.6)
Free use	7.0	(0.5)	4.5	(0.5)	11.1	(0.5)
Income quartiles						
Ownership ratio (%) by income quartile						
1	22.9	(0.6)	21.3	(1.7)	38.2	(1.4)
2	44.2	(1.5)	38.4	(2.0)	64.0	(1.6)
3	53.0	(1.0)	52.6	(1.8)	79.4	(1.3)
4	71.2	(0.5)	68.7	(1.5)	91.5	(0.8)
Tenancy ratio (%) by income quartile						
1	64.5	(0.6)	70.2	(2.1)	46.5	(1.4)
2	48.9	(1.1)	56.7	(2.0)	20.8	(1.4)
3	41.8	(1.1)	45.0	(1.9)	12.5	(1.1)
4	25.7	(0.8)	29.6	(1.5)	2.9	(0.4)
Free use ratio (%) by income quartile						
1	12.6	(0.1)	8.5	(1.4)	15.4	(1.1)
2	6.9	(0.5)	4.9	(0.9)	15.2	(1.2)
3	5.2	(0.3)	2.5	(0.5)	8.1	(0.9)
4	3.2	(1.3)	1.7	(0.5)	5.6	(0.7)
Net worth quartiles						
Ownership ratio (%) by net worth quartile						
1	1.2	(0.3)	8.0	(1.0)	2.7	(0.5)
2	12.9	(1.3)	18.2	(1.9)	75.4	(1.2)
3	82.7	(1.3)	64.8	(2.0)	96.7	(0.5)
4	93.9	(0.5)	88.5	(1.3)	98.3	(0.3)

Tenure status (%)						
	AT		DE		IT	
Tenancy ratio (%) by net worth quartile						
1	88.1	(1.5)	86.4	(1.6)	67.4	(1.4)
2	74.3	(1.7)	75.2	(2.0)	13.0	(1.0)
3	14.6	(1.3)	30.7	(2.0)	1.5	(0.4)
4	4.4	(1.7)	10.5	(2.0)	0.6	(1.0)
Free use ratio (%) by net worth quartile						
1	10.7	(0.8)	5.6	(1.2)	29.8	(0.2)
2	12.8	(1.3)	6.6	(1.3)	11.6	(1.4)
3	2.7	(2.6)	4.5	(1.2)	1.8	(1.0)
4	1.7	(0.2)	1.1	(0.8)	1.1	(0.4)

Source: own calculations based on HFCS, PHF, SHIW.
Standard errors in parentheses.

Italy has the highest ownership ratio (68%). Ownership rates in Austria (48%) and Germany (45%) are markedly lower (see Table 1)[7]. Free use is much more widespread in Italy than in Austria or Germany. In all three countries, the share of homeowners increases in line with income. Conversely, free use declines as net income increases. This might be explained by the fact that free use housing is often provided by family and friends to young or retired relatives or – in Italy in particular – by public sector entities as social housing[8].

Since Italy has the highest share of homeowners and the lowest share of indebted owners, one may conclude that Italian households are less affected by interest rate changes and rental market developments. In addition, the high share of free use should translate to lower housing expenses[9].

There are also differences across countries with regard to the average size of the primary residence. The median surface area is 90 square meters in both

[7] Data from Eurostat show the following ownership rates: 55% in Austria (2016), 52% in Germany (2016) and 73% in Italy (2015). For Austria, families living in homes owned by relatives are also regarded as owners. Without these households, the share of owners amounts to 51%. For Germany, the ratio relates to the share of individual persons living in an owner-occupied home. Translated to reflect the share of households, the figure is 43%.

[8] According to HFCS data "free use" housing is mostly provided by family members in Austria and by family and friends in Germany (the German survey does not differentiate it). Although provision of free use accommodation by relatives is also common in Italy (with 30% of all accommodation being for free use), provision by private individuals that are not relatives is even more common (45%). In contrast to Austria and Germany, a significant share of free use accommodation in Italy is provided by public sector entities (18%).

[9] Free use does not imply that these households do not pay operating costs. Furthermore, the part of housing expenses that is not borne by the inhabitants of a free use accommodation must eventually be paid by other households.

Austria and Italy and 83 square meters in Germany. Regarding the surface area per earner, Austria and Germany show lower results (median: 65 square meters) than Italy (median: 70 square meters). However, the average number of household members is higher in Italy than in Austria and Germany. Additionally, the mean equivalized[10] household size is highest in Italy (1.7 compared to 1.5, both in Austria and Germany). This fits the fact, that the median home size per household member is smaller in Italy (43 square meters) than in Austria and Germany (50 square meters in both countries). Concerning the number of employed or self-employed persons within the household, the Italian number is lower than the Austrian and German (mean 1.75 in Austria and 1.57 in Germany compared to 1.53 in Italy). This is not astonishing regarding the fact that the Italian women's employment rate is second lowest in Europe[11] (48% compared to 68% in Austria and 71% in Germany, according to Eurostat data for 2016).

Some features of the national housing markets might help to explain the differences in home ownership ratios. One factor driving the preference for home ownership in Italy may be housing policy. The 1970 s saw a burst of regulatory activity that included the passage of the Fair Rent Act in 1978. By contrast, these efforts were neglected in the 1980 s and some features of the laws and norms that had been enacted in the previous years were repealed, thus changing the laws' corrective impact (Caruso, 2017). In that decade home ownership was promoted through the adoption of new provisions (Caruso, 2017). As a result, the rental market shrank steadily while the owner-occupied market grew. After the financial crisis, credit institutions tightened lending rules, which fueled demand for rental housing. Because social housing is not widespread (Bianchi, 2014, and Chart 1), affordability is especially limited for low-income households. The situation is especially problematic in metropolitan areas (Pittini et al., 2015). Aassve et al. (2002) have shown that in southern Europe, more than elsewhere, leaving the parental home depends on employment and income. Often the original family has to take an exclusive role in supporting young people in this transition (Mencarini and Tanturri, 2006). According to the Italian survey data for 2014, 28.2% of households had inherited their primary residence or received a substantial gift (in 1989 the percentage was 26%). The respective ratio is 27.3% in Germany and 28.1% in Austria. Using data from the 2004 IDEA survey, Mencarini and Tanturri (2006) show that about 65% of young people living outside the parental home in Italy received funds from their parents to purchase or rent a home. German

[10] The equivalized household size is the number of consumption units in the OECD modified scale (1 + 0.5 * number of people 14 years and above + 0.3 * number of children below 1 year old).

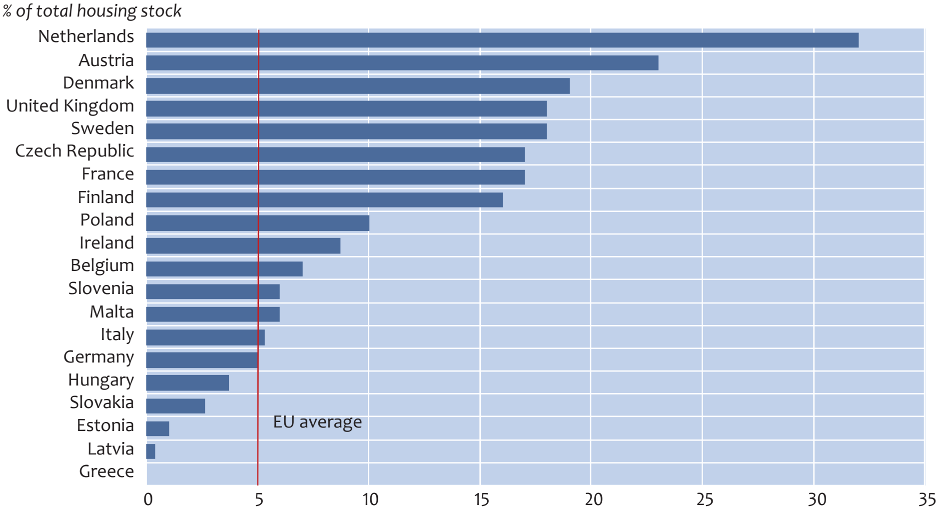
[11] Women's employment rate shows a big difference between northern and southern regions in Italy.

PHF data show that about 13% of households in Germany received support from persons outside the household when acquiring their primary residence. Data on support for tenants is not available for German households. In Italy, house prices have increased dramatically over the past two decades and Italy's labor market and pension system have both undergone various reforms. Together, these changes have worsened the economic conditions of young Italians (Berloffa and Villa 2010). Modena and Rondinelli (2011) point out that young people in Italy leave home relatively late compared with other countries, citing the rather small Italian rental market (around 20% of total housing), weak housing policies that offer little in the way of social rented housing for young people, high transaction costs on the housing market, and the difficulty of obtaining a mortgage without providing guarantees (Mencarini and Tanturri, 2006). According to Mencarini et al. (2010), young Italians emancipate five years later than their French counterparts[12]. Modena and Rondinelli (2011) find that in Italy the probability of leaving home decreases by about one half of a percentage point for a one standard deviation increase in house prices and show that the youngest cohort was heavily impacted by the evolution of real estate prices in the last decade.

Chart 1

Social housing share 2012

% of total housing stock



Source: CECODHAS Housing Europe.

[12] The HFCS data also show that Austrian and German households bought their primary residence when the survey reference person was 33 years old while in Italy the reference person was 36 years old.

In Austria, the rental market is highly regulated and comparatively large. Austrian housing policy targeted and still targets low- and middle-income households to provide them with adequate living space. Austria's housing policy rests on several pillars. First, a housing subsidy program provides subsidized loans to individuals, cooperatives and corporations. The second is the nation's legal framework, which consists of private law, building regulations and property development regulations. Besides the Tenancy Law, which targets the private rental market, there is another law that applies to non-profit housing developers, the Limited-Profit-Housing Act. Under this act, limited-profit housing associations are allowed to charge a rent that just covers costs. They must also reinvest any profits in Austrian housing projects. A further pillar is the subsidy given to building and loan associations and mortgage banks. Social housing plays an important role in the Austrian housing market, with 23% of the total housing stock used for social rental housing. To sum it up, Austria has quite many ways of subsidizing households (subsidized mortgage loans, tax deductibility of housing expenses[13], subsidy scheme for tenants, etc.) which is not accounted for in our results of housing expenditures (as we do not have data on these items within the HFCS).

Germany's homeownership rate is 52% and therefore comparable to Austria's rate. An important difference compared to Austria is that the social rental market is much smaller (around 5%). Germany's Limited-Profit-Housing Act was phased out on December 31, 1989, and many dwellings that had been regulated until then were released from tenancy regulations.

Austria has a system of regulated rents that allows for surcharges or discounts depending on factors such as the rental property's location for contracts concluded after March 1, 1994, for houses built before May 8, 1945. On the contrary, Germany has a very loose principle of comparable properties, with a regular survey on rents in a number of German cities serving as a reference framework[14]. In Austria, the above-mentioned tenancy agreements stipulate that rent increases are indexed by the consumer price index and rent increases after refurbishments are handled quite restrictively. In Germany, rents may be increased if owners incurred renovation costs or if comparable rents are higher[15]. However, in Austria no such restrictions exist for

[13] The tax deductibility of housing expenses (e.g., loans for renovation purposes) has been cancelled most recently. For existing loans concluded prior to 1 January 2016 the old rules are still valid for five years till 2020. For new loans, the cancelation applies with the tax statement for the calendar year 2016.

[14] In Germany, two measures impose limits on rent increases: the cap which stipulates that rents may be increased by no more than 20% (in some cities 15%) within 3 years, and the survey-based reference framework of comparable rents, which constitutes upper limits for rent increases.

[15] Austrian law also requires a 25% discount to be applied to rents payable on regulated flats if the contract term is limited. The minimum duration of a limited-term lease is 3 years.

buildings constructed after 1945. It means that Austrian rents in such buildings (17% of the entire Austrian housing market) are less regulated in Austria than in Germany.

Effective June 1, 2015, new rent-control legislation was introduced in various German districts. The new regime stipulates that rents for new contracts must not exceed the local average rent by more than 10%. The effects of the new regime have been hotly debated. Many experts see distortions in the real estate market as rents have increased quite sharply in many cities since the summer of 2015 (e.g., Kholodilin et al., 2016). Tenants may be avoiding moving out, preferring instead to extend their leases because sitting tenants' rents are much lower than new rentals. In September 2017, Berlin's district court declared such provisions unconstitutional, finding them to discriminate against some landlords.

3. Current housing expenditure

Table 2

Housing expenditure													
		AT				DE				IT			
		mean		median		mean		median		mean		median	
All		28.6	(0.1)	25.6	(0.1)	36.6	(0.6)	30.8	(0.5)	21.6	(0.3)	16.6	(0.2)
Owners		20.7	(0.2)	17.6	n.a.	30.8	(1.1)	25.1	(0.6)	19.0	(0.3)	15.2	(0.2)
without loan		17.3	(0.2)	15.6	(0.2)	24.4	(0.5)	20.6	(0.4)	16.4	(0.2)	13.9	(0.2)
with loan		29.4	(0.4)	26.0	n.a.	45.4	(3.1)	37.2	(1.1)	37.5	(1.3)	33.1	(1.1)
share of loon-related payments (average)		44.6	(0.5)			57.2	(1.1)			62.6	(09)		
Tenants		39.2	(0.1)	37.0	(0.2)	43.7	(0.9)	36.8	(0.8)	36.4	(1.1)	31.0	(1.0)
share of rent payments (average)		58.2	(1.0)			63.2	(0 4)			70.8	(06)		
Free use		14.1	(0.2)	11.7	(0.3)	19.6	(1.5)	17.0	(1.3)	10.1	(0.5)	8.5	(0.4)
	1	41.3	(0.2)	39.9	n.a.	60.3	(2.4)	49.9	(1.2)	33.7	(1.2)	26.5	(0.7)
Income	2	30.2	(0.1)	28.7	(0.4)	34.7	(0.6)	32.6	(0.4)	23.6	(0.5)	20.8	(0.4)
Quartile	3	24.8	(0.3)	22.6	(0.8)	28.6	(0.6)	26.8	(0.6)	17.9	(0.3)	14.9	(0.3)
	4	18.1	(0.2)	15.7	(0.3)	23.1	(0.6)	20.5	(0.5)	12.8	(0.2)	10.4	(0.2)
Net	1	40.6	(0.4)	39.8	n.a.	50.8	(1.7)	43.1	(1.4)	30.3	(1.1)	25.0	(0.8)
worth	2	31.4	(0.5)	29.9	(0.5)	36.1	(1.0)	32.7	(0.5)	22.6	(0.5)	19.0	(0.6)
quartile	3	23.3	(0.6)	20.1	(0.5)	32.1	(1.0)	28.3	(0.8)	18.0	(0.4)	14.9	(0.3)
	4	19.2	(0.4)	16.4	(0.2)	28.0	(1.8)	21.3	(0.6)	16.1	(0.4)	13.1	(0.3)

Source: Own calculations based on HFCS, PHF, SHIW.
Standard errors in parentheses.

Comparing the current housing expenditure in the three countries (Table 2), we see that the housing expenditure is lowest in Italy (mean: 22%, median: 17%) and highest in Germany (mean: 37%, median: 31%). The mean Austrian housing expenditure is 29% (median: 26%)[16]. On average, tenants have a higher current housing expenditure than owners. The difference between the average current housing expenditure of tenants and the average current housing expenditure of owners is about nineteen percentage points in both Austria and Italy but only thirteen percentage points in Germany. The difference between tenants and owners with an outstanding loan is less distinct, particularly in Germany and Italy. In all three countries, the housing expenditure decreases as income increases. The drop in the housing expenditure from the first to the fourth net income quartile is most pronounced in Germany, where the difference in the mean housing expenditure equals thirty-seven percentage points. The trend is the same when the housing expenditure is broken down by net worth quartile. It should be borne in mind that the share of homeowners is relatively small in the first net worth quartile but relatively large in the highest net worth quartile. For many households in the fourth net worth quartile, a debt-free primary residence constitutes a large part of their net worth.

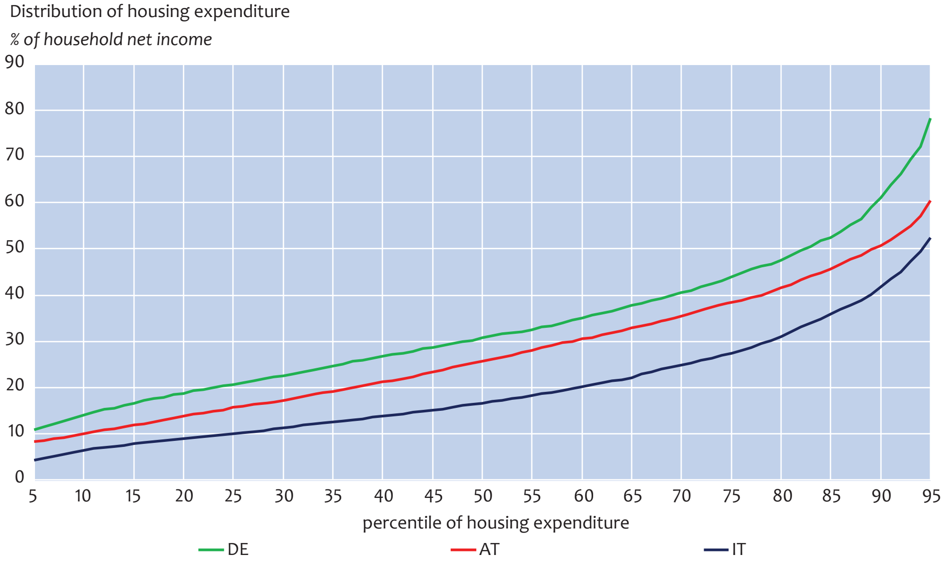
Chart 2 shows the distribution of the current housing expenditure between the 5th and the 95th percentiles. The spread between the three lines is smallest at the lower end of the distribution and grows as they move into the higher percentiles. The shape of the distribution curve is quite similar in Austria and in Germany although the curve for Germany lies consistently above the Austrian one. The Italian distribution has a somewhat different shape. In particular, it is flatter at the lower percentiles and steeper at higher percentiles. The relatively flat part of the Italian distribution up to about the 65th percentile indicates a more equal distribution and reflects the large proportion of owners without outstanding loan debt who have a relatively low expenditure. The proportion of owners with outstanding debt to service on their primary residence is much lower in Italy (12%) than in Austria (28%) and Germany (30%)[17]. The steeper slope after the 65th percentile reflects the higher expenditure of the relatively small group of Italian owners with outstanding loans and tenants. In all countries but especially in Germany, high values for the

[16] One could argue that household income should be adjusted by an equivalence scale that accounts for the number of household members. We chose not to do that because our interests focus on actual expenditure ratios. An analysis centered on households' needs should apply equivalence scales. Calculations show that – at least with respect to averages and medians – the use of equivalence scales would not affect the order of the results presented in Table 2.

[17] Thus, even though the proportion of owners is higher in Italy than in Germany and Austria, the proportion of households that have an outstanding loan to finance the primary residence is lower in Italy (8%) than in Austria and Germany (both around 13%).

housing expenditure can be observed for the higher percentiles. The slope of the distribution also increases markedly. Data suggest that mostly low-income households exhibit such a high expenditure. However, it must be borne in mind that the number of households with an extremely high housing expenditure is relatively small. Therefore, the estimates have to be taken with caution. This also holds for the distribution of the housing expenditure of owners and tenants (discussed below).

Chart 2

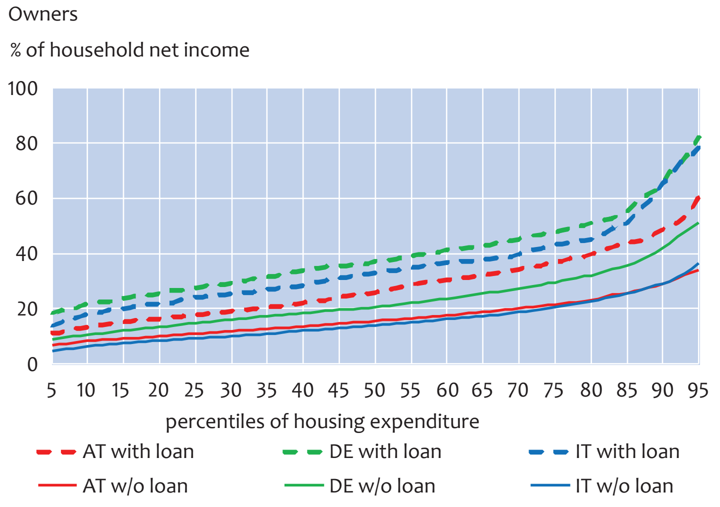


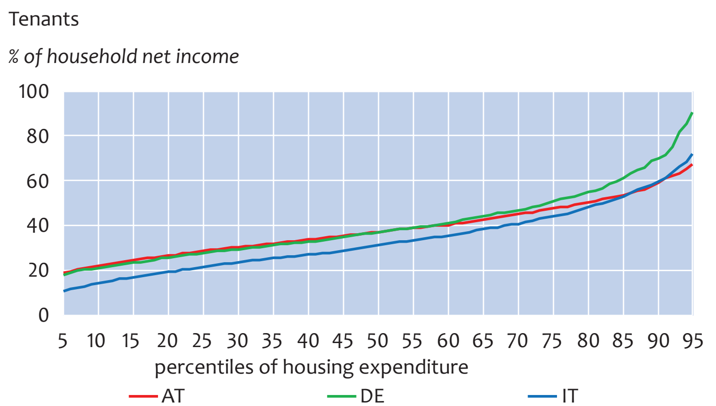
Source: HFCS 2014 Austria, SHIW, PHF, OeNB.

Next, we compare the housing expenditure of owners and tenants. A major determinant for the current housing expenditure of owners is whether they have an outstanding loan (see Chart 3, upper panel). The difference between the current housing expenditure of owners with and without loan debt is more pronounced in Germany and Italy than in Austria. The difference between the median current housing expenditure of indebted owners and that of owners without debt is 10% in Austria, 17% in Germany and 19% in Italy. Loan repayments of indebted Austrian owners account on average for only 45% of the housing expenditure. This number is considerably higher in Germany (57%) and Italy (63%, Table 2). Differences in the outstanding loan amounts are one factor causing the disparity in the housing expenditure among owners with an outstanding loan. On average, indebted Austrian households have about 90,000 EUR in outstanding loans to finance

Chart 3

Distribution of current housing expenditure





Source: HFCS 2014 Austria, SHIW, PHF, OeNB.

their primary residence (median: 64,000 EUR). This number is somewhat higher in Germany (mean: 99,000 EUR; median: 80,000 EUR). Outstanding loans among owners are distributed differently in Italy than in Austria or Germany. Outstanding loans of indebted Italian owners amount to 77,000 EUR on average, with a median of 70,000 EUR. Differences in interest rates, mortgage characteristics (duration, initial period of fixation, etc.) also play a role. For example, the average original duration is twenty-six years in Austria and twenty-six years in Italy but only thirteen years in Germany. That implies that German households have to pay back their loans in a shorter time period. Regulatory differences concerning the division of housing expenditures between tenants and landlords and other topics are also partly responsible for the differences in the levels of housing expenditure across the countries studied. The quality of housing may play a role when analyzing the amount of housing expenditure. There is no information in the HFCS on the building age of the main residence. Looking on the breakdown by the duration of living in the main residence we see higher housing expenditures in the first twenty years, later on the amounts are lower (up to ten percentage points). Therefore, it is not possible to analyze more thoroughly the effect of building standards and resulting country differences. Nevertheless, building characteristics and regulation standards may impact household's housing expenses.

Regarding the distribution of tenants' current housing expenditure, the lower panel of Chart 3 shows that the housing expenditure of Italian tenants is about six percentage points lower than the expenditure of German tenants across most of the distribution. Up to about the 60th percentile, the distribution of the current housing expenditure in Austria and Germany is almost identical. Above the 60th percentile the slope of the distribution increases in Germany whereas the Austrian distribution approaches the Italian one. The flatter slope of the Austrian distribution reflects somewhat more equality in the housing expenditure of tenants in Austria. Tenants with a high housing expenditure are mostly low-income households.

Overall, the size of the share of ownership and tenancy in a country accounts for a large part of the differences in the housing expenditure across countries. The relatively low current housing expenditure in Italy can be largely explained by the high ownership ratio and the low incidence of outstanding loans that were taken out to finance the primary residence among owners. However, that does not mean that financing housing is particularly easy for Italian households. On the contrary, as discussed above, it is relatively difficult for young people to establish their own first households because of the relatively small supply of cheap rental apartments and relatively high property prices. Italian households are larger than Austrian and German households. Thus, housing expenses are distributed among more people.

In addition to the housing expense, we discuss the vulnerability of owners in the following paragraph. Vulnerability can be defined in several ways (see e.g., Albacete et al., 2013). We take advantage of the fact that data on net income are available and calculate the total debt service ratio of owners. For this purpose, we do not only take into account debt services for loans taken out in order to purchase the primary residence (as above) but also the debt service for loans for the purchases of other real estate as well as consumer loans. As vulnerability is particularly important from a financial stability point of view we restrict our attention to owners with outstanding debt. The analysis shows that the median debt service ratio of these households amounts to 12% in Austria, 19% in Italy and 20% in Germany. In Austria, about 95% of these households have a debt service ratio below 40% (and 80% spend less than a quarter of their net income on debt service). The corresponding numbers for Italy and Germany are 83% (63%) and 88% (65%) respectively. Indebted households are most likely not able to reduce their housing expenses easily if they get in trouble with servicing their debt. Hence, we also calculated the ratio of housing expenses (as defined in the previous sections) plus debt service for loans that were taken out for other purposes than financing the main residence to household net income.

This indicator takes the median values of 27% in Austria, 31% in Italy and 39% in Germany. In Austria about 80% of indebted owners spend less than 40% on housing expenses plus total debt service (and about 44% less than 25%). In Italy, 68% spend less than 40% (33% less than 25%) of their net income on housing expenditures plus total debt service. In Germany this is only the case for 51% (16%) of indebted owners. Comparing these results with the results on housing expenditures suggests that in Italy loans for other purposes than the primary residence play an important role and increase debt service payments of indebted owners.

Final conclusions

Housing expenditures usually make up the largest share of household consumption. In this article, we calculated the current housing expenditure of households in Austria, Germany and Italy using 2014 data from the second wave of the HFCS.

Disregarding households that can use their primary residence for free, we find that in all three countries owners without outstanding loans for the purchase of the primary residence have the lowest current housing expenditure. The high share of this group in Italy explains the low Italian current housing expenditure. However, despite this low current housing expenditure, structural features of the Italian property market make it difficult – especially for young people – to establish a household. Our study analyzes the current housing expenditure and not housing expenditures over the life-cycle. An analysis of housing expenditures over the life-cycle that also considers earlier expenses on loans that have already been repaid might yield a different picture with regard to both the differences between owners and tenants within a country and the housing expenditure across countries.

This article aims to give in initial impression of the differences in the housing expenditure across the selected countries. A next step would be to more thoroughly analyze the reasons for these differences while also extending the countries sample. Although the HFCS data considerably improve comparisons of the housing expenditure across European countries, differences still exist between the national survey questions. For example, the reported operating expenses might differ across the surveyed countries, thus affecting the comparability of total housing expenses. Availability of net income data for all countries in the HFCS would be another welcomed improvement as it would allow for many important international analyses.

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Annex

In this annex we discuss particular details of the surveys used.

Austria

Survey: We used national data from the second wave of the HFCS (see Albacete et al., 2016).
Operating costs: Respondents are asked "How much does your household spend on ancillary housing costs (electricity, gas, water, sewage, phone, internet, television)

in a typical month?" Interviewer guidance indicates that energy costs (e.g., heating, electricity) should be considered and that loan repayments do not fall into the category of ancillary housing costs. Owners are asked to record operating costs. Tenants are requested to state their rent both including and excluding operating costs.
Housing cooperatives: Tenants in flats provided by housing cooperatives often have to contribute to building costs. We include loan repayments (principal and interest) for loans taken out to finance this redeemable funding contribution. The contribution to building costs is reimbursed upon termination of tenancy, less depreciation. Because we apply an expenditure approach, we do not take this depreciation into account in the calculation of housing expenditures.
Bullet loans: Owners are asked whether they have an outstanding bullet loan for the acquisition of the main residence. We calculated expenses arising from these loans using information on current interest rates and loan amounts.

Germany

Survey: We used the PHF Scientific Use File Wave 2 Version 1.0 data set (see PHF Survey Team, 2017).
Operating costs: Households are asked to state the ancillary costs including utility costs (heating, electricity). In a separate question, households are requested to give the expenditures on landline phones, mobile phones and internet access.

Italy

Survey: We used national data from the 2014 Survey on Household Income and Wealth (SHIW) from Banca d'Italia (Banca d'Italia, 2015).
Operating costs: Households are asked for expenses relating to the main dwelling for condominium costs including any heating costs, electricity, water and gas (if not included in the condominium costs) and landline telephone, including any internet connection costs.
Household income: To improve comparability with net income information from the other surveys, we added interest rates paid and transfers paid to and subtracted imputed rent from the net income variable provided in the survey (called y in the data set). Of the households surveyed, forty-two have no income. For these households it is not possible to calculate the expense ratio. Also, some households have a very low monthly income (sometimes even below 1 EUR). Due to such low income results in an unrealistically high expense ratio (up to more than 2000), we set the expense ratio for households with an income below 150 EUR to missing.

Chapter 11

Moral hazard of indebted households as a potential threat to macroeconomic stability – observations from the Spanish real estate bubble

Piotr Kasprzak[1]

Introduction

Basing the economic growth on the housing bubble has exposed Spain to huge macroeconomic imbalances and the social change, which currently require decisive policy actions and specific monitoring. Despite of strategies for the recapitalization of financial institutions, rebalancing of the country's current account and the reduction of the private sector debt, one particular underestimated topic deserves closer attention: the phenomenon of moral hazard.

Moral hazard of banks "too big to fail" has been profoundly symptomatic to the contemporary economic reality. One could also observe countries and local governments behaving similarly. The big question is: What if households believed that they were liberated from financial risks by governments acting on constitutional guarantees of the right to housing?

This is potentially an important sociological issue, with major economic consequences. In a scenario of growing interest rates, moral hazard of households could be a serious factor causing future macroeconomic imbalances.

The article's theoretical findings indicate rent seeking of social groups (Olson, 1982) and moral hazard as superior to other laws governing the behavior of homo sapiens oeconomicus and place them amongst main factors destabilizing modern

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economies dominated by the financial system (Minsky, 1986). First observations of their possible consequences lead to sweeping changes of the Spanish political scene and a growing pressure on the country's economic and legal frameworks. Considering the reflexive nature (Soros, 2008) of these phenomena, future tensions in macroeconomic policy are highly probable.

The paper calls for further research of households' moral hazard. Expected results shall not only empirically contribute to behavioral finance theories but also generate practical data that ought to be reflected in any future macroeconomic actions.

1. Moral hazard in the contemporary market economy

"*Moral hazard* refers to any situation in which one person makes the decision about how much risk to take, while someone else bears the cost if things go badly" Paul Krugman (2009).

The multiple meaning of words forming the term *moral hazard* reflects the substance of this phenomenon. As it can be found in the Oxford Advanced Learners Dictionary (1994), the word *moral* might be interpreted as: ethical (internally recognized by people as correct and proper) or probable though not proved (as in the moral certainty), while *hazard* is not only a risk (e.g., in gambling) but also a danger. Although *moral hazard* could literally be rephrased to ethical game or ethical risk, its use in the original ambiguous form seems to be more adequate for not depriving it of the aspect of danger and not suggesting that this attitude is a result of an informed choice in the game.

It is essential that this is not a typical casino bet that expels a player for a loss, but an immoral bet where the player exposes a loss to someone else. *Moral hazard* is then an action of putting somebody at risk of a loss that can be morally questionable.

According to Dembe at al. (2000) this term has been in use for more than two hundred years and it originates in the eighteenth century England, where insurance companies defined it as an abusive behavior of insured people resulting just from the fact that they were insured. Later, *moral hazard* was used not only in relation to accidents at work as a result of deliberate actions, but also due to negligence and inattention caused by the greater confidence of insured employees.

The concept of *moral hazard* entered the broader economic debate in the 1960s, among others in the work of American Nobel laureate Kenneth J. Arrow (as a description of the individual's decision-making process in risk situations). For detailed review see Arrow (1968).

Although nowadays some researchers still associate *moral hazard* with ordinary insurance fraud[2], it is a faulty approach because it deprives the phenomenon of unconscious, unintended conduct resulting from behavioral aspects of the human nature, and restricts it to conscious actions of illicit nature[3].

Today's economic literature is dominated by analysis of *moral hazard* in relation to the financial sector. The phenomenon is referred to as an abuse of the dominant position of the sector in the economy and often mentioned among the main causes of the last financial crisis. Examples of occurrences arising from it, such as: the underestimation of risk of banking products, market manipulations, creative accounting and informational asymmetry, are numerous. One should also emphasize the lack of transparency of transactions, partly related to increasing complexity of financial and economic processes and their scale. For details see a lecture of the head of the International Accounting Standards Board (IFRS), the Dutch politician, banker and economist, Hans Hoogervorst (2014).

Although causes of *moral hazard* in banks are primarily sought in the "weakness of the market mechanism" or the "weakness of the supervising authorities", it seems more appropriate to consider what has been the true reason of the systemic acceptance of this phenomenon for decades (at an unprecedented scale in the history of modern economics) and how it can be prevented in the future.

An example of the model description of this phenomenon in the financial sector is a concept of the *moral hazard* credit cycle developed by another American Nobel Prize winner Roger B. Myerson.

His model (Myerson, 2012) shows how the microeconomic *moral hazard* observed in financial institutions translates into a macroeconomic destabilization of the economic system. The model is based on a defined lack of long-term relationships between employees of financial institutions (bankers) and capital providers (investors). The fundamental necessity for the economy to concentrate small portions of capital (to provide it to entrepreneurs) is burdened through financial institutions, which decide where to direct this stream. These decisions are made by bankers, who are exposed to temptation to pursue their own goals. This observation is in line with the assumption of the institutional economist and social scientist Mancur Olson, that the pursuit of maximizing the return on already secured resources, positions and rights (so called: *rent seeking*) is easier than using them to produce added value, thus superior to other mechanisms ruling the behavior

[2] Related to statistically important increase in house fires due to falling property prices, see Eriksen (2012).

[3] To distinguish, a conscious, opportunistic and oriented to cheat the system action of this type is referred in literature to *morale hazard.*

of a person and a group, Olson (1982). This causes a possibility that behavioral *rent seeking* of bankers (in a situation of limited liability and responsibility towards investors) makes a basis for their *moral hazard*[4].

Due to the highest importance of the financial sector, *moral hazard* plays an essential role in the contemporary economic system. Banks are too big to fail and actively use the public support. Cases of bankruptcies and criminal or civil liability of bankers are sporadic, although a scale of the deceit is gigantic and its consequences are socially perceptible.

According to R.B. Myerson, the effective solution to this problem should be a pressure to create long-term relationships of bankers with investors by imposing long-term remuneration contracts with remittances at the end of their validity. Another method would be to allow new intermediaries to the financial sector, which would reduce the concentration of decisions[5].

R.B. Myerson's approach to *moral hazard* is based on the traditional vision of the banking sector, where capital providers and entrepreneurs meet. However, in the context of a dominant position of the state and its seemingly unlimited capacity to create money, the role of the first group deteriorates.

Another important process observed nowadays is a growing significance of banks' newly discovered mass customer – the mortgage debt bearing household. Furthermore, this co-existence of state institutions, banks and households translates into a system of correlative relationships and influences, which are an essential element of the modern economic reality.

In the face of the "big government" capitalism, as described by Minsky (1992), and the aforementioned effect of displacing investors and capital providers from the economic system, the role of the state, its institutions and voting households is formed. It should be analyzed with special attention to the reverse impact of behavioral and social phenomena such as *rent seeking* and *moral hazard* in the economic system, as they are increasingly noticeable.

To assume that the premise of R.B. Mayerson's model is correct and to replace the financial system with the political system that decides on the allocation of financial streams generated by banks, main conclusions may be analogous. Such reasoning is logically permissible in the form of fulfilled deductive inference or at least potentially deductive argumentation (Ajdukiewicz,1974). While it is widely

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[4] On top of that, the bonus remuneration system (focused on current profits) increases the distance between managers of the banking sector and the rest of the economy, and the short-term view of the enterprise value prevails.

[5] Like the online crowdfunding platforms, which are gaining popularity especially in the field of financing of new technologies.

acknowledged that the financial system is exposed to *moral hazard* of its employees, there is little economic analysis of its role in the case of politicians, government employees and regulators. However, it is highly probable that they are exposed to the behavioral temptation to pursue their own goals (similarly to bankers), which also has a short-term nature linked to the electoral cycle.

Such reasoning about the human aspect of the political system's nature is justified with regard to the knowledge gained from observations of the reality and the ineffectiveness of the political system in:

- loudly postulated by politicians "control over the market mechanism",
- liquidation of advantages of the financial sector in the economic system,
- avoiding further crises, despite the increasing scope of state interventionism.

It is also important to underline that the housing policy is a powerful tool for social impact[6]. At the same time, the growing importance of the real estate sector in the economy is unquestionable. The temptation to use it for short-term electoral goals is thus powerful.

Effects of such actions can be empirically observed in a series of studies confirming the existence of the political business cycle that is a result of a government's economic policy, as shown by Weiss (1991) for example. This real estate cycle research has presented that due to an influence of the public opinion and political aspects of the real estate and financial markets, there is a tendency for governments not to take actions to stabilize the booming market as it would be unpopular with prevailing optimism. That fulfills the definition of *moral hazard*, as the government, protected by its growing popularity, takes risk at the cost of future generations.

Accepting, after Mancur Olson (1982), that the society consists of groups guided by interests of the individuals forming them (*inter alia*: politicians, voters (households) and interest groups) it can be found that similar mechanisms lie at the heart of their actions. By analogy, it is then highly probable that *moral hazard* could also affect household attitudes. This occurrence could be attributed to the belief that households, which buy property (financed by long-term bank loans), are protected by economic policies of the state against potentially negative consequences of their financial decisions.

If the accepted premise is the existence of behavioral *moral hazard* in each of the distinguished social categories, and if reflexive nature of their actions is the acknowledged assumption, as described by Soros (2008), then the conclusion is: behavioral *moral hazard* is a common factor characterizing actions of these groups.

6 For example, according to sociological research, the right to housing is ideologically valued by the American society more than the right to participate in elections, see Shlay (2006).

This thesis has the highest importance for the functioning of the whole economic system and its nature, as *moral hazard* is driven by the pursuit of *rent seeking*, resulting from the human nature, thus superior to other laws.

The influence of *moral hazard* on the market economy based on the real estate system[7] is as follows:

- Banks, supported by governments, acting in the belief that they are too big and influential to fail (*moral hazard*) use aggressive financial innovations that translate into rising real estate prices.
- Politicians convinced of their electoral security, act in pursuit of the desired housing policy that leads to growing debt of the society (*moral hazard*).
- Households, being able to purchase residential property for an acceptable portion of their current income, accept liabilities that will be repaid for decades without regard to their future financial standing (*moral hazard*) and give support to the government that offers this policy.

The functioning of this mechanism requires the state to provide households with acceptable conditions for acquiring real estate. Because of predominant credit purchases, this means low interest rates and a pressure on increased money creation. The government is experiencing increased tax revenues and, although the economy is growing in an unbalanced way, as its structure changes, it is able to support the policy of having your "own home", which is met with social support that translates into electoral voices. Households purchase real estate on credit, not only for their own needs, but also as an investment, with all its consequences (both micro and macroeconomic). In this way, decisions of the government, banks and households affect the economic situation causing certain perception that leads to further mutual actions i.e., they function in the reflexive loop. Everybody gets richer as real estate prices rise. The government gets its support, bank managers their bonuses, households seemingly affordable housing (even though highly indebted). The cycle closes and heaves increasingly wider circles, covering less affluent social strata. There the effect is much stronger, although the risk of the system is apparently diluted with the use of financial innovation (like securitization of subprime loans).

Macroeconomic consequences of this mechanism can be observed primarily by changes in the structure of the economy (with growing shares of banking and real estate sectors), and ousting of capital providers and savers from the system. This regards entrepreneurs as well, as their role is likely to be systematically reduced, in the result of growing tax burdens (due to the need to support the financial

[7] In the systemic market view, see Bryx (2008).

system) and reduced availability of non-mortgage related capital markets, as banks increasingly concentrate their activity on crediting households, the construction sector and the government. The dependence of the economy on the banking system, so called: *bank bias* – term used first by Langfield et al. (2015), is growing.

In the aftermath, internal demand for labor, construction related materials and means of production is increasing too fast relative to the economy's potential, and must be met by imports. This results in a sharp increase in immigration and deterioration of the trade balance. The growth in number of immigrants supports more demand for housing and gives further spin to prices. The economic bubble grows until it bursts, with all its negative consequences.

Spain is a good example of this sequence, where in the recent years there has been a spectacular, but an unsustainable economic growth based on the housing market, followed by a deep financial and economic crisis. It has led to significant structural changes in the Spanish society that were mirrored in its political scene.

3. The Spanish economic boom and bust of the first decade of EMU

"If the Titanic sinks, the first-class passengers will be sacrificed too" José Manuel García-Margallo[8].

When the first signs of the imminent crisis in the international financial markets were observed in the year 2007, Spain's economic situation seemed to be very good. The economy had been growing for several years. Ratings of the EU and ranking institutions were positive. The global crisis was treated as an external factor, hindering further economic growth, at that time. Even already in the face of a deep economic collapse in 2012, in the opinion of the Spanish government, it was triggered by global events, not by internal and structural unbalances of the country's economy[9]. This rhetoric prevailed at all levels of the political debate, also with other countries of the European Union, and the first stabilization actions reflected it. However, in spite of tens of billions of euros invested in further boosting of the domestic demand in years 2008–2010, they did not succeed. Spain was forced to accept the European bailout deal, even though it had been rejected before.

8 "Si el Titanic se hunde, se sacrificará también a los pasajeros de primera clase" – a statement of Spain's Foreign Minister, on the EU in the context of German pressure to adopt the plan to restructure Spanish banks in 2012 (http://www.rtve.es/noticias/20120608/margallo-advierte-alemania-si-titanic-se-hunde-se-hundiran- tambien-primera-clase/534095.shtml).

9 http://politica.elpais.com/politica/2012/03/01/actualidad/1330625687_550946.html

Interestingly, growing economic imbalances in Spain were visible before the peak of the real estate price bubble. The Spanish central bank *BDE* already pointed out in 2003 that the property market was overvalued and that the Spanish banks were too exposed to the external financing[10]. According to Santos (2014), although many economists indicated the rising real estate bubble, fragile public finances and the dangers of growing private debt contributing to the destabilization of the country's external account, this voice was ignored too.

Research of Alesina et al. (1991) shows that stabilization measures taken by governments are often influenced by different pressure groups trying to shift their negative impact on other social groups. The process involved in the selection of stabilizing actions is a kind of war of influence, in which each group reasonably tries to delay adverse effects on this group. According to historical observations, countries often do not take the necessary course of action or sustain their unfavorable direction in the long run, although it becomes apparent.

The history of the last Spanish boom and bust cycle of the economic growth based on the housing market begun after the country's accession to the European Monetary Union (EMU) in 1999. This was the moment when Spain had gained a wide access to cheap financing that later contributed to economic imbalances and the economic crisis.

Implications of this groundbreaking event were mainly related to Spain's opening to external capital markets, and its resignation from the low-cost model of growth[11]. The foreign exchange risk was eliminated and the convergence of interest rates began (Figure 1).

Falling interest rates and the country's reduced investment risk profile led to lowering of discount rates and a relative depreciation of financial assets. This has contributed to an increase of investment attractiveness of the Spanish real estate, for both domestic and foreign investors.

Aside of the country's improving economic situation, the growth of demand for residential real estate was additionally supported by specific conditions in Spain at that time, like: changing demographic (a reduction of the relative size of households) and the traditionally high participation of property ownership in the society.

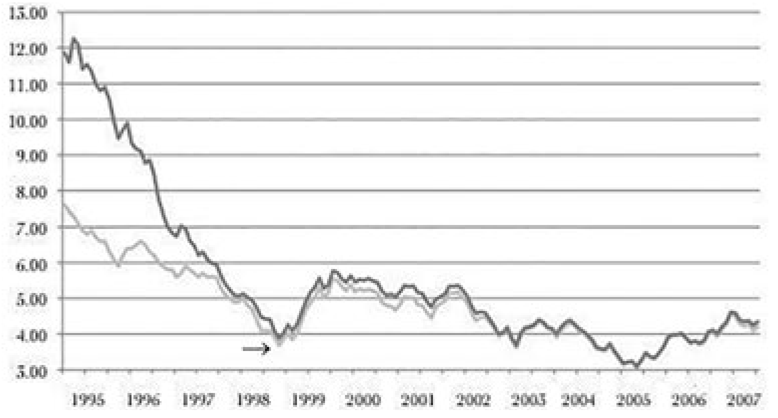
Also, due to the fact that the grey economy was broadly unfolded in Spain, the amount of hidden cash money was significant. It is estimated that the introduction

10 BDE estimated that property prices were between 8% and 20% higher than the equilibrium level, according to valuation models used. For details see BDE (2003).

11 Devaluations of the Spanish currency were frequently used to protect competitiveness of its economy in previous decades.

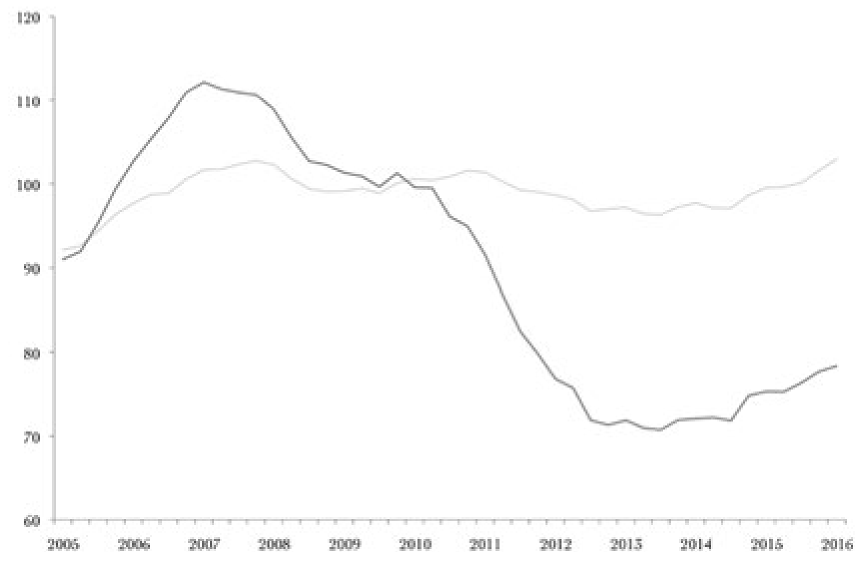
of the euro led to legalization of hidden funds through the real estate market too (calculated to at least a few percent of GDP)[12].

Figure 1. 10-year government bond yield in years 1995–2007 (%); Spain (dark line), Germany



Source: fred.stlouisfed.org.

Figure 2. Annual price changes of residential real estate, measured by the HPI index in years 2005–2016 (2010-100); Spain (the dark line), EU15



Source: Eurostat.

12 https://elpais.com/diario/2002/04/03/economia/1017784811_850215.html

Consequently, prices of residential real estate in Spain almost tripled in nominal terms between years 1998 and 2008. The average price of a square meter apartment rose from € 760 in 1998 to € 2,100 at the peak of the price bubble in 2008.

In the last two years before the global turmoil of 2008, the level of the EC house price index (HPI)[13] in Spain was higher than the European average by 10 percentage points. The dynamics of its growth exceeded the threshold of 6% twice. It is important to underline the real approach to price changes as measured by the HPI, given the fact that the consumer price inflation in Spain was already more than 2 percentage points higher than the European average at that time. The HPI graph (Figure 2) also shows no cyclical changes and corrections in the rapidly growing market. Similarly, the scale and dynamics of the price decline in the years of the crisis are much deeper than the average of other European countries.

Boosting demand for residential real estate provoked a surge in their construction. The supply of Spanish dwellings in relation to population exceeded three times the European average at that time. The number of flats built each year, between years 2000 and 2008, went beyond the total of residences built in Germany and France together. About 4.5 million new dwellings were constructed, representing an average of 0.5 million per year. At present it is only about 40 thousand flats i.e., 6% of the level from the top of the price bubble (Figure 3).

As a result, a share of the construction and the real estate sector in the gross value added by the Spanish economy increased from 16% in 2000 to 20% in 2008. Changes of just the housing construction's share, compared to the EU15 average (Figure 4), indicate more than a double disproportion in the years of the price bubble, a deep correction during the crisis, and the current leveling off.

Although booming construction had contributed to Spain's spectacular economic growth, which amounted to 3.5% on average between 2000 and 2008 (1.9% in the EA), it was an unbalanced increase.

The Spanish economic expansion of this period can be described as the model example of development based on the internal demand and the policy of boosting tax revenues (see Fernández-Villaverde et al., 2013). The Spanish government's opinion on the very good economic situation of the country was strong[14] at that time. The state budget reflected the objective of building the welfare state by stimulating the domestic demand. Generous social programs became commonplace, such as stimulating family growth and tax reliefs on real estate purchases, etc.

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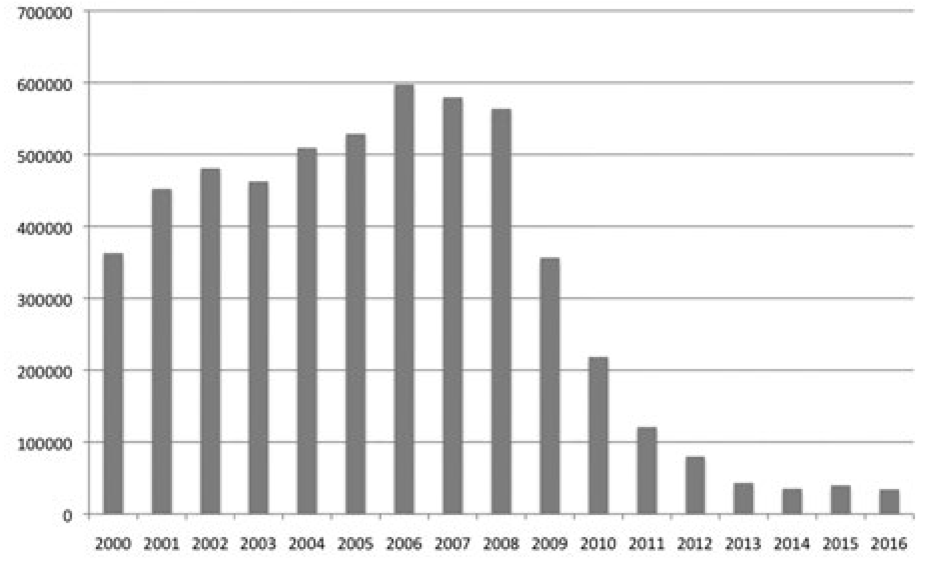
13 The annual growth rate in the deflated HPI. It is a part of the scoreboard of indicators used in the Macroeconomic Imbalances Procedure (MIP) of the European Commission.

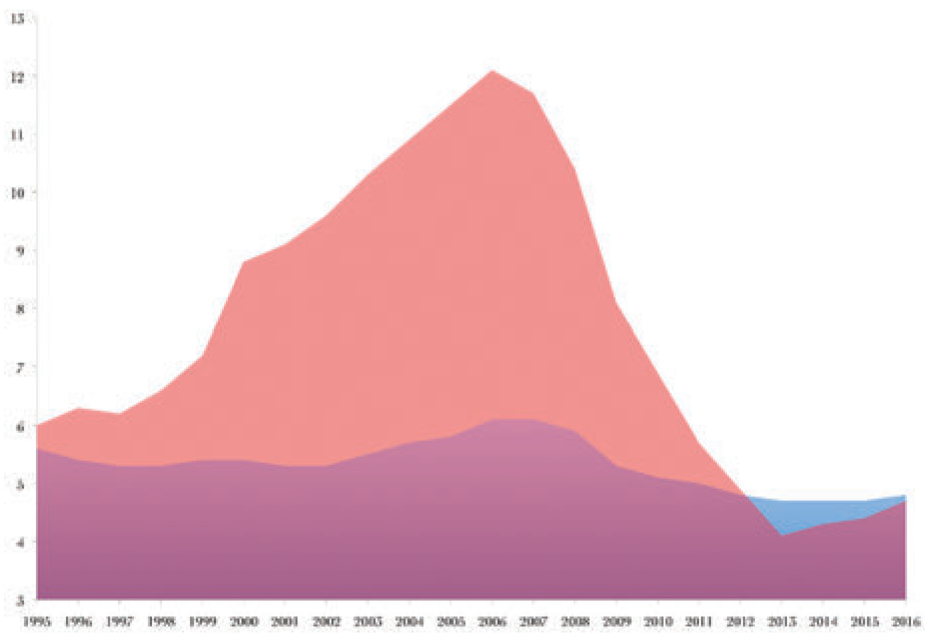
14 In January 2007, the Prime Minister of Spain at that time, José Luis Rodriguez Zapatero (the president of the Spanish Socialist Party PSOE), announced that Spain would outpace Germany in a few years (https://elpais.com/diario/2007/01/15/espana/1168815614_850215.html).

Figure 3. Number of finished dwellings in years 2000–2016; Spain



Source: The Spanish Ministerio de Fomento.

Figure 4. Share of the housing construction in GVA in years 1995–2016; Spain (red), EU15



Source: OECD.

Structural changes of the Spanish economy are clearly visible in its breakdown into tradable (*T*) and nontradable (*NT*) economic sectors. Such an approach is used both in the OECD and the EU methodology, according to Zeugner (2013).

Table 1. Shares of *NT* and *T* sectors in GVA in years 2000–2015; Spain

	2000	2008	2015
NT (nontradable)	47%	53%	52%
T (tradable)	53%	47%	48%

Source: Eurostat[15].

The *NT* part includes activities of the construction sector and real estate related (also property development) with professional activities (legal, consulting, etc.), the public sector and the financial sector[16]. The *T* sectors cover industrial and agricultural production, trade and services with a special position of tourism[17].

The share of the Spanish tradable sector (*T*) decreased from 53.0% in 2000 to 47% in 2008 (Table 1). In nominal terms, the gross value added of the nontradable sector doubled (an increase of 272 billion EUR), while the tradable sector increased by only by 54% i.e., 167 billion EUR. It is worth noting that as a result of the crisis, Spain's GVA was 46 billion EUR lower in 2015 than in 2008, and the disparities between the *NT* and *T* sectors decreased (Table 2).

Table 2. Structure of GVA in years 2000–2015; Spain

(billion EUR)	2000	Share	2008	Share	2015	Share
GVA, incl.:	586	100%	1026	100%	980	100%
(*T*) industrial and agricultural production	145	25%	209	20%	204	21%
(*T*) trade and services	165	28%	269	26%	270	27%
(*NT*) construction, real estate and professional activity	131	22%	280	27%	243	25%
incl. real estate activity	*35*	*6%*	*92*	*9%*	*110*	*11%*
(*NT*) the financial sector	27	5%	55	6%	39	4%
(*NT*) the public sector	117	20%	213	21%	224	23%

Source: own calculations based on Eurostat data.

15 http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=nama_10_a10&lang=en

16 The analysis does not reflect the real contribution of the financial sector to GVA of the economy, considering failures in valuation of banking assets.

17 The importance of the tourism sector for the Spanish economy should be emphasized. It currently produces over a dozen percent of the Spanish GDP and employs 1.5 million people. Undoubtedly, the strong position of this sector has helped the Spanish economy cope with the crisis.

According to the generally accepted thesis that it is better to produce machines than homes and that the *T* sector is more flexible, export oriented and less inflationary, the increase of the *NT* sector's share in GVA was unfavorable for the Spanish economy. This growth was based mainly on the internal demand, so it was more prone to local conditions of the government's economic policy. Stimulating domestic demand brings fast tax effects, while an alternative model of economic growth, primarily based on the export growth, does not generate such significant tax revenues in the short term. Although it is more profitable for the economy's development in a longer term, it translates into a smaller public budget and certainly is not a preferred model for politicians because of its implications for public spending, as underlined by Keohane at al. (1999).

Table 3. Trade Balance (Products and Services) as % of GDP; Spain, EU15

	2000	2007	2010	2013
HISZ	**–3.1**	**–6.7**	**–2.2**	**2.4**
EU15	0.5	1.0	1.0	2.7

Source: Eurostat.

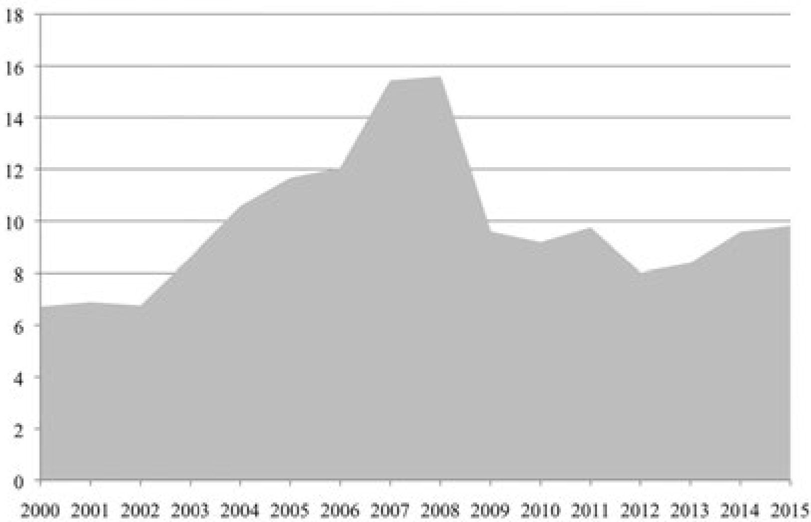
The dynamic growth of the Spanish economy was also accompanied by growing imbalances in the country's external accounts. Although exports grew dynamically, domestic demand-driven imports grew much faster. This continued to deepen the trade gap (Table 3), and combined with a large influx of capital, led to growing external dependence of the economy. As shown in Figure 5 imports of machinery and equipment increased from 6.7 billion USD in 2000 to 15.7 billion USD in 2007 to drop to 8 billion USD in 2012. The significant changes were undoubtedly related to the boom in the construction sector.

Spain's economic growth of years 2000–2008 was achieved with a drastic increase in the indebtedness of the economic system, mainly its private part i.e., companies and households (Table 4).

As a consequence of the crisis and stabilization actions, the total debt further increased and is now more than two and a half times higher than in 2000, but its structure has changed. Nowadays the public debt represents around 100% of the country's GDP (90% in the EA) with a tendency of a slight decrease (from 99.8% in 2015 to 99.4% in 2016), while households (even though deleveraged in comparison to the record high of 2010 by 23 percentage points) still were at the level of 115% of GDP in 2016[18].

[18] http://ec.europa.eu/eurostat/web/products-datasets/-/tipspd20

Figure 5. Imports value (machinery and equipment) from Germany in years 2000–2015 (billion USD); Spain



Source: https://wits.worldbank.org.

Table 4. Sector debt as % GDP; Spain

	2001	2006	2010	2016
Public	54%	39%	60%	99%
Households	82%	135%	138%	115%

Source: own calculations based on Eurostat and OECD data.

3. Growing dependence of the economy on the banking sector

"Where is the cash flow?" Hyman P. Minsky (1986).

There is a striking resemblance of the boost and bust sequence of the Spanish economy to evolutionary processes of the contemporary capitalism system theoretically described by Minsky (1982). He has indicated the government supported development of the real estate sector that led to the undermining of the traditional role of mushrooming banks and triggered off government deficits (in reaction to negative effects of the deepening economic cycles), and structural changes in the economy. The growing importance of the banking sector stirs up *moral hazard* and *rent seeking* behaviors.

Table 5. Capitalization of the Madrid Stock Exchange (MC) and total banking assets (BA) between years 1995–2015; Spain

(% GDP)	1995	2000	2008	2012	2015
MC	101	85	58	75	65
BA	177	181	289	351	324
BA/MC[19]	1.8	2.1	5.0	4.7	5.0

Source: own calculations based on data.worldbank.org, OECD.

Between 2000 and 2008, the relative importance of the banking sector in the Spanish economy (the aforementioned *bank bias*) increased significantly. The total value of bank assets in relation to the market capitalization of companies listed on the Madrid Stock Exchange has risen sharply (Table 5). At the peak of the housing market bubble in 2008, it amounted to five and has more than doubled in comparison to the 2000 level. During the crisis, total bank assets reached 351% of Spain's GDP. Even though it fell during the financial crisis it still remains at the highest European levels.

This growing dependence of the Spanish economy on the banking sector is best seen in the development of its mortgage market, which had a value of 632 billion EUR at its 2010 peak, as reported by BBVA (2016). Between 2000 and 2007, the average annual growth rate of loans to the general public in the Spanish banking sector equaled 17.8%, followed by Irish (18.4%) and Greek (17.5%), among the highest in Europe. For comparison, in Germany it was 1.1% and 7.4% on average in the EU. The share of real estate related lending in total private sector loans increased from 14.5% in 2000 to 61% in 2007.

To mirror the situation of the Spanish economy on the eve of the financial bubble, a specific role of local savings banks *(cajas)* and their strong position in the financial system should be underlined. A decentralization of political and executive power over the Spanish regions, divided administratively into autonomous communities *(comunidades autónomas)*, was reflected in the banking system. Regional *cajas*, which financed the implementation of local projects, were therefore significantly affected. As these banks were not listed, they lacked independent shareholders and proper corporate and risk management. According to a study of the largest 20 *cajas,* the share of political representation in their administration exceeded 50%. For details see Azofra-Palenzuela (2004).

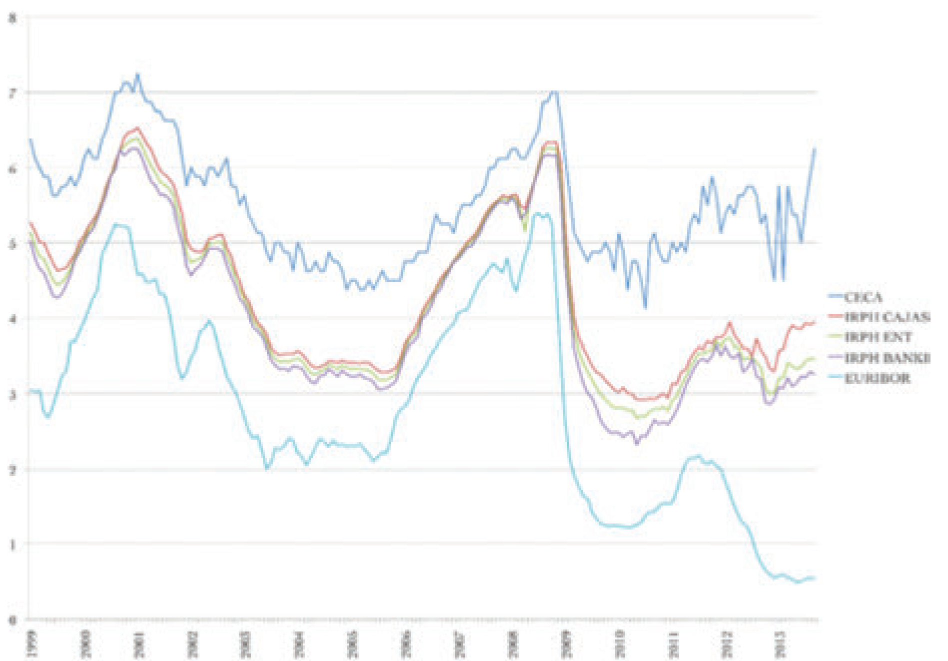
According to BDE (2017), during the period of the real estate bubble, the Spanish *cajas* increased the number of branches by 30% and of the staff by 32% and

19 BA/MC (bank assets/marketcap ratio).

they took stronger position on the market than banks. Processes that were taking place in Europe at that time, related to the consolidation of retail banking, were reversed and the number of employees and branches decreased. Today, despite the subsequent crisis, the density of Spanish bank branches is still more than double that of the European average, as observed by Maudos (2012).

Not only Spanish banks and *cajas* were enjoying the booming market, but little competition could be observed, and specific indexes and clauses in credit agreements used. As a result of the convergence of interest rates in the euro area, cost of lending in Spain was significantly reduced at that time. However, as can be seen in Figure 6, the mortgage credit rate in the Spanish market (measured by individual reference rates)[20] did not change in line with European interest rates. During the Spanish real estate bubble, mortgage loans (almost entirely based on variable interest rates) were usually 2 to 4 percentage points higher than Euribor (aside of commissions and bank fees).

Figure 6. Mortgage reference interest rates in years 1999–2013, Spain



Source: BDE.

[20] During the time the following official mortgage reference rates were determined by the central bank BDE: MIBOR, CECA, IRPH (with variants) and Euribor.

For example, a specific method of construction of the *IRPH* index draws attention. This was an income index (not a cost index), which allowed banks for an inclusion of additional commissions and fees. It also cut off the price of the loan from the actual price of money and in fact changed the nature of the interest rate from variable to fixed.

Moreover, the *IPRH cajas* index structure, which was based on the simple arithmetic mean of credit prices of all *cajas*, allowed the small *caja* to affect the height of the index in a disproportional scale to its market share. Each of forty-six *cajas,* existing at the end of 2007, were submitting monthly quotes of their loan prices to calculate the index. So, to illustrate, *La Caixa* (the sum of loans granted: 162 billion EUR) and *Caixa Pollença* (259 million EUR i.e., six hundred times less) had the same effect on the ratio[21]. Raising the price of credit by a very small *caja* resulted in an increase in the valuation of the index in the entire banking sector. At the same time, the potential loss of its market share, due to the higher price of the loan offered, was not reflected in its weight in the index. The level of the *IRPH* index grew, which created a stream of additional profits for the entire sector. This system could provide a wide field for controlling of the price of credit.

Another example of currently questioned practices by Spanish banks during the housing price bubble were additional clauses in mortgage contracts providing for a minimum level of bank income in case of falling interest rates, such as *cláusula suelo*[22].

As a result of the economic crisis and the mortgage market near breakdown, a public pressure has appeared to consider abusive use of the aforementioned indexes and clauses.

There was a precedent in challenging the legality of using the *IRPH* credit reference rate in April 2014, when a San Sebastian judge found that it was possible to manipulate its use and that the borrowers were not sufficiently informed about the performance of this index. In March 2015, a similar sentence was issued by a Barcelona's court. Also, as a consequence of the central reform of the fallen *cajas*, two of the three *IPRH* (*cajas* and *bancos*) index subclasses were liquidated. Today, although the *IRPH* index is not defined as unlawful, its use is deemed illicit unless it is clearly communicated by the bank in credit agreements. It has practically lost its reason. *Cláusula suelo* has been considered as abusive[23] and currently banks offer their clients deals that limit their potential claims.

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21 BDE's answer for 15 questions on the *IPRH*, from the Madrid Economic Court (15 May 2015).

22 In literal translation: the floor clause.

23 https://elpais.com/economia/2017/02/16/actualidad/1487245628_985764.html

Future consequences for the Spanish banking sector of losing the campaign could be very serious. Surely, potential compensation costs (estimated at billions of euros) that would burden the banking sector and indirectly public finances, are currently being considered in the discussion on abusive practices, also on the European level. Regardless of future developments, the whole process is indicative of *moral hazard* and the *rent seeking* activity during the bubble years in Spain.

4. The bubble related social change[24] reflected in remodeling of the Spanish political scene

"It's a magic night in Spain. And probably these days are the starting days for the change" Pablo Iglesias[25].

Various interesting qualitative changes of the Spanish society took place during the economic boom and bust sequence, primarily caused by the rapidly growing demand for labor in the construction sector and the growing economy.

After creation of the EMU, one third of all new jobs in the area were created in Spain. The EC (2014) analysis of the Spanish employment indicates significant changes in its structure. There was a shift of labor force towards the *nontradable* sector, whose share in total employment increased from 47% in 2000 to 52% in 2007. In the construction, the real estate and the financial services sector, the bubble peaked 3.4 million employees in 2007, an increase of 2.1 million compared to 2000 (the crisis has left more than 1.5 million of them unemployed).

The huge demand for labor caused a **massive immigration** wave that has passed through the system in the bubble years. The number of registered foreigners in Spain increased from 2% of the population in 2000 to 12% in 2010 i.e., by 4.8 million people (Table 6). This was the highest in Europe and the second in the world (after the United States) economic migration at the time.

The origins of Spanish immigrants (mainly South America and Northern Africa) indicate primarily economic reasons for the migration, as concluded by Jimeno et al. (2009). A huge part of this group (employed in the construction sector) lost jobs during the crisis.

It is worth pointing out that in spite of a significant number of immigrants returning to their countries of origin, which was connected with the Spanish

[24] In the sociological sense, exhibiting functional and structural changes of the society.

[25] The statement of the *Podemos* party leader, after the elections that have ended the two-party political system in Spain in 2015 (http://www.euronews.com/2015/05/25/spanish-voters-punish-mainstream-parties-in-local-and-regional-elections).

economic turmoil, two million foreigners have already obtained Spanish citizenship and the right to vote. The increase in their significance in the political context might have further consequences to changes of the Spanish political scene[26].

Table 6. Number of registered foreigners in years 1991–2014; Spain

(million)	1991	2000	2007	2010	2014
population	39.3	40.3	45.2	46.6	46.3
immigrant	0.4	0.9	4.5	5.7	5.0
share	*1%*	*2%*	*10%*	*12%*	*11%*

Source: own calculations based on INE and Eurostat data.

Spanish boom and bust has highly influenced the younger part of the society. During the bubble years young Spaniards abandoned education due to high demand for labor. Young people leaving school at an early education level found employment mainly in the construction and the tourism sector, with low qualification requirements. Changes in the ESL indicator (early school leaving)[27] shown in Table 7 confirm the opposite trend in Europe between years 2001 and 2006. Even though high unemployment affected whole Spain significantly in the following years in the result of the crisis, the **unemployment among Spanish youth** is among the highest in Europe (next to Greece) and corresponded to 42.9% in December 2016 (EUav: 18.6%)[28].

Table 7. Early school leavers aged 18–24 measured by the ESL; Spain, EUav

	2001	2006	2015
HISZ	28.6	36.7	24.0
EUav	19.4	17.4	12.4

Source: Eurostat, European benchmarks in education and training (EC 2002, p. 20).

As mentioned before, the economic boom ended with intensive **indebtedness of Spanish households**. Not only the total number of indebted households reached 50% in 2008, but the share of households holding mortgage debts, and thus potentially vulnerable to *moral hazard*, is still increasing (Table 8).

26 https://elpais.com/elpais/2015/12/15/inenglish/1450182701_858546.html

27 It measures the percentage of people completing education before reaching a certain grade on a given level of education, such as a high school diploma in the secondary level.

28 Data: www.statista.com

Table 8. Percentage of households with bank debt in years 2002–2014; Spain

	2002	2008	2011	2014
indebted in total, incl.:	43.6	50.0	48.6	48.8
mortgage debt, incl.:	28.1	34.2	35.9	37.2
for primary property	*21.6*	*26.3*	*26.5*	*28.1*
for secondary property	*6.5*	*7.9*	*9.4*	*9.1*

Source: Encuesta Financiera de las Familias EFF (INE 2005, 2011, 2014).

Consequently, their reflexive influence on the processes described in the paper is intensifying. Detailed data additionally reveal a higher exposure of lower-income households to banks, as the share of debt servicing costs in their income has a negative correlation. On average, the debt service to income ratio accounted for 18.1% of income on the average, and 38.5% for the 20% lowest income households in 2014 (Table 9). More than half of indebted households spend a quarter of their incomes servicing debt.

Table 9. Share of bank debt servicing costs in the income of Spanish *hogares* (debt service-income ratio) in years 2002–2014

	2002	2008	2011	2014
Average	14.5	19.0	18.4	18.1
Percentile 20%	*30.5*	*39.2*	*46.2*	*38.5*

Source: Encuesta Financiera de las Familias EFF (INE 2005, 2011, 2014).

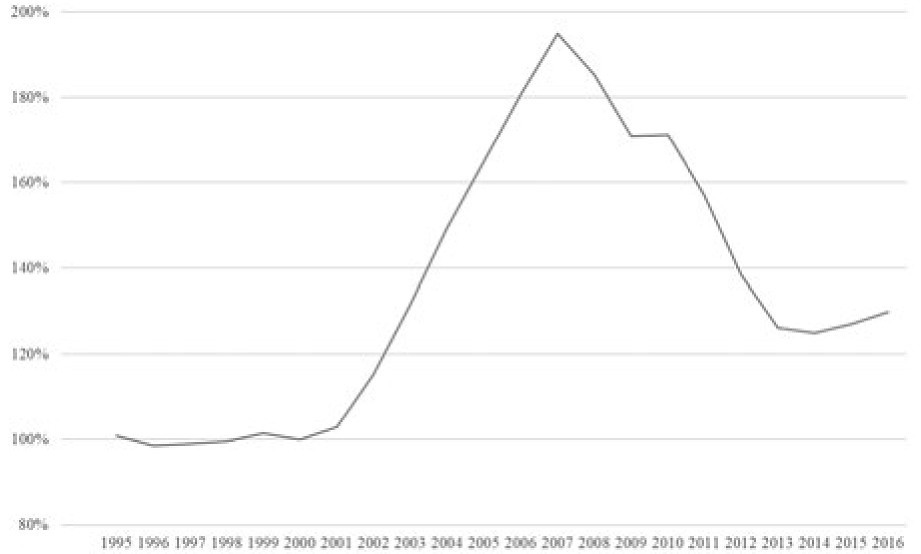
These results indicate an increased exposure of Spanish households to the banking sector in the years 2002–2014. Although it improved compared to the crisis peak of 2011, it still outstrips the 2002 level.

It is important to note as well a significant variation in the availability of housing due to adjustments in their prices and the economic situation of Spanish households. While the index stood at a relatively stable level before the year 2000, during the time of the bubble (despite the real increase in household disposable income in booming economy) it has risen sharply (Figure 7). At present, although it has been corrected as a result of falling housing prices, it is 30% higher than in 2000. While this aspect of basing economic growth on the housing sector would require separate studies, it seems probable that the **deterioration in the availability of housing** might also have socio-political repercussions.

It is worth mentioning that Spanish boom ended with the global crisis, at its first stage, led to a wave of household insolvency and ouster resulting from it.

Evictions and property repossessions, which amounted to 350 thousand cases between years 2007 and 2012, for details see LE (2012), gave ground to widespread social protests and triggered off processes of self-organization.

Figure 7. House price to income ratio per capita[29] (1995-2016), 2000=100; Spain



Source: OECD[30].

Debate over changes in the Spanish law[31] began with a local court's in Navarra ruling (in December 2010) to limit the borrower's liability for unpaid loans after transferring ownership of the seized property to the bank. The judge justified, among other things, that the decline in the residence value was a consequence of the financial crisis triggered by banks, and consequently it was immoral for them to demand additional repayment from the debtor[32]. Although it was difficult to maintain the sentence in the light of the applicable law, the finding was a precedent.

Under the influence of social protests and courts, banks began to use donations as a form of debt relief *(dación en pago)* at the acquisition of real estate being subject to default mortgage loans. As revealed by Carbó-Valverde et al. (2013), an

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[29] OECD's price to income ratio is the nominal house price divided by the nominal disposable income per head and can be considered as a measure of affordability.

[30] https://data.oecd.org/hha/housing.htm#indicator-chart

[31] Spanish mortgage law is one of the most restrictive in Europe. Under the Civil Code, the borrower is liable to the bank not only with the property being subject to the credit agreement, but with all his present and future patrimony (recourse law).

[32] Auto 111/2010 de la Audiencia Provincial de Navarra, sección 2ª, de 17 diciembre 2010.

organization representing bank customers affected by mortgages (*Plataforma de Afectados por la Hipoteca, PAH)* collected in 2012 1.5 million signatures requesting the Spanish parliament to debate mortgage law changes towards *non-recourse* solutions. In the following local and later parliamentary elections, all political parties voted in favor of protection of borrowers and easing eviction laws[33].

It should be noted that in the climax of the crisis in 2013 immigrants made up more than 80% of total people evicted[34]. Only the next wave of evictions took over the young job losing Spanish middle-class families.

In the following years there has been a **fundamental change of the Spanish political scene** and the end of the existing, traditional, two-party system. During the parliamentary elections in December 2015, the two dominant *PP* (conservative) and *PSOE* (socialist) parties lost a total of eight million votes, which were cast for new political parties: *Podemos* (We can) and *Ciudadanos* (Citizens). Today there are four main parties in the Spanish parliament with a similar number of votes, which for several months choked the establishment of a new government in 2015. The parliamentary crisis, which took place after the 2015 elections (that were repeated in 2016) lasted nearly two years.

While it is yet too early to draw clear conclusions by linking changes of the Spanish political scene with the housing policy of its government, it is obvious that the economic crisis, which amongst others was a consequence of basing the country's growth policy on the housing market, was an important factor[35].

Conclusions

"It's frightening to think that you might not know something, but more frightening is to think that, by and large, the world is run by people who have faith that they know exactly what is going on" Amos Tversky (1937-1996)[36].

[33] Including new parties, which were created on the basis of the social movement launched in May 2011 (*El Movimiento 15M*), such as the *Podemos* party which currently has more than 20% of votes in the parliament.

[34] As evictions hit 6 of 15 thousand Ecuadorian immigrants, the president of Ecuador accused Spain of failing to comply with the fundamental human rights to justice and dignity, before the European Court of Human Rights.

[35] According to OECD (2015) while the level of confidence of citizens towards their governments has decreased globally by 3.4 points (from 45.2% to 41.8% on average in the OECD countries in 2007–2014) this includes a decrease in confidence by 27 points in Spain along with increased confidence by 25 points in Germany.

[36] (https://www.goodreads.com/author/quotes/72452. Amos_Tversky).

The resulting conditions of Spain's significant, but changing structures of the economy and the society, economic growth, favored the accumulation of *moral hazard* at all levels; from central and local governments, through banks and businesses to households. These were as follows:

- dominant position of the developed, retail, privately owned banking system (*bank bias*); resistant to foreign competition, whose structure was strongly dominated by highly political *cajas*,
- decentralization of the state's control in favor of the regional administration, especially in the field of land management,
- the state's strong support of the real estate and the construction (NT sectors), more than the determination to implement structural reforms of public finances,
- a growth in the internal consumption of households as a result of increased employment and wages, and a sharp improvement of optimism among consumers and entrepreneurs, boosted by falling interest rates to the historically lowest levels.

Due to the reflexive nature of the economic phenomena, it is difficult to determine the causality of events of the Spanish boom and bust cycle. It can be noted though that the real estate heat has been launched with the breakthrough occurrence of Spain's accession to EMU.

The intuitive way of learning leads us to the question of why in Portugal, entering EMU in the same year as Spain, there was no significant increase in real estate prices at that time? (For details see Fradique-Lourenço et al. (2014)). After all, the climatic and cultural factors boosting demand of foreign investors are close to the Spanish. The answer seems to be the coexistence of Spain's specific "*moral hazard* sensitive" conditions listed above.

After years of prosperity Spain is now a highly indebted country, both in the public and the private sectors. Although economic recovery is present, the question is about its sustainability, especially as one can observe reflexive changes on the political scene that might impact the country's future economic policy. Households have already led to revisions in the law on bank evictions and the nature of mortgage agreements. And the potential influence of their *moral hazard* is growing with the increasing indebtedness of the society.

The research approach presented in this paper has been confined to describing the *moral hazard* phenomenon in a new context of households and a logical confirmation of its existence. The next step must be its recognition as one of the key factors destabilizing the market economy and taking it into account in the economic debate, both theoretical and practical.

The detailed investigation of *moral hazard* of households should be the direction of further research, due to the ballooning reach of this phenomenon. Since its nature arises from behavioral roots of human decisions; rational in their actions but also subject to emotions and heuristic thinking, with a natural drive to *rent seeking*, its influence is superior to other laws and factors affecting the economic reality. This paper **calls for a large-scale public opinion research** of households in this context, using representative methods.

There is a growing body of empirical literature showing that extensive household debt can have significant lowering effects on economic growth as over-leveraged households reduce consumption in order to secure debt servicing e.g., as reported by the IMF (2017). The thesis that the relationship between household debt, the economic growth and financial stability may depend on behavioral factors affecting household consumption pattern, and therefore influence other parts of the economy, is generally accepted. The extent of this impact depends on the country's ability to absorb shocks, associated with its monetary and fiscal stance, the degree of dependence on the external financing, the quality of supervision and regulation and stabilization policies.

At the same time there is less attention paid to reflexive effects of mass expectations and actions toward governments realizing housing policy. Expected research results shall not only empirically contribute to behavioral finance theories but also generate data that ought to be practically reflected in the macroeconomic policy.

Although the paper's findings portray the Spanish case, some warnings and recommendations on the economic policy for future euro zone member states (including Poland) could be drawn. The most important universal conclusion is, that it is necessary to observe not only the real structure of the fast-growing economy and its changes, but also the resulting social change, since in the long run they will have a reverse effect on the observed processes.

The significance of public *moral hazard* will grow, especially with regard to the observed shift of the state power-society relations, reinforced by the influence of social media, the phenomenon of fake news, self-organizing social groups, etc. There is no doubt that housing finance is now one of the most important areas of economics and the link between approaches represented by different social sciences. Followed by required research methods, it can produce entrancing results. It is necessary to develop this field without any delay because the dynamism of changes and their reflexive and real effects will have more than a fundamental influence on the future socio-economic reality.

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Chapter 12

Estimation of housing prices – comparison of spatial methods in Warsaw housing market

Joanna Waszczuk[1]

Introduction

Hedonic price models are the most popular methods used to estimate the value of real estate around the world. Moreover, residential real estate market price dynamics is usually calculated on their basis. The quantity of goods and their market prices are influenced by market expectations and observations, of both – customers and sellers. Therefore, real estate prices may be affected by various elements, such as: location (general and detailed), the usable area of a flat, construction technology or standard. The econometric model allows for the simultaneous inclusion in the analysis of a greater number of attributes than the descriptive analysis. The problem is that often location factor is included in a model but in an insufficient manner, there is still a spatial pattern that can be seen in distribution of residuals (see Waszczuk, 2013).

It is important to stress that the real estate market data have spatial character, thus the market should be analyzed using appropriate methods that take into account location of the property and the impact of neighborhood. Geostatistical methods are based on statistical models which regard spatial autocorrelation. They use interpolation to estimate the value in places where there is no measurement data available. Price maps, which reflect patterns in the spatial distribution of house prices within a city, are especially important for valuers and banks.

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In addition, the importance of the proper valuation of real estate is also important because of its strong connection with the economy through the banking sector (see Lambertini et al., 2013). The problems of households with repayment of housing debt may lead to problems with liquidity and solvency in the sector, leading to real housing crises causing problems for the real sphere (US example, see Goodman and Thibodeau, 2008; Duca et al., 2011). The recent experiences with the US crisis proved that problems with housing loans repayments are risk factors that can threaten financial stability and have an impact on housing prices. The source of the current credit crunch in the US and some EU countries is the expansion mechanism of mortgage banking generating erroneous premises for risk management, mainly as a result of the revaluation of collateral (see Pawłowicz, 2007).

This article aims at stressing the impact of spatial dependence on house prices predictions. In this paper, besides theoretical description, the empirical computation of three chosen geostatistical methods is presented. The paper is organized as follows. Chapter 2 presents the literature review of housing market prices models and spatial methods of their estimation. Chapter 3 provides information on methodology framework used in this paper. Chapter 4 contains empirical results for Warsaw housing market and Chapter 5 concludes the analysis.

1. Literature review

In the recent literature there are two approaches of modeling housing prices that take into account spatial distribution of housing prices: econometrics and geostatistics. Spatial statistics and econometric methods started to develop in the first half of the 20th century (see Moran (1948) and Geary (1954)). In 1970 Tobler formulated the first law of geography by stating that "everything is related to everything else, but near things are more related than distant things" and a dynamic growth of spatial analyzes occurred. In 1978 Paelinck published an article on spatial econometric models' specification, identification, estimation and testing. Anselin in 2005 and 1995 presented econometric models that deal with spatial dependence and heterogeneity and described indicators of spatial correlation. The econometric methods usually employed to analyze house prices are, traditionally, hedonic regressions. It is assumed that also the structural characteristics of the building (age, size, bathrooms, etc.) are included in a model. In the case of hedonic regression the number of variables that influence housing prices is large and the characteristics are heterogeneous. As a result, identifying all relevant neighborhood's characteristics within the city may be problematic. Moreover, the correlation between the explanatory variables causes multicollinearity problems. All these arguments are in favor of using other methods of predicting housing prices.

Geostatistics is another approach to measure spatial correlation of data at various points in three-dimensional space. It originated in the 1950s in the mining industry. Krige – a South African mining engineer and Sichel – a statistician, created new estimation methods. In 1962, Matheron basing on Krige's work expanded this concept, formalized it and named it "kriging" after Krige. The acceptance and popularity of these methods have grown steadily and significantly since then. Right now geostatistical techniques are applied in diverse disciplines including: geology, hydrology, meteorology, geography, environmental control, landscape ecology agriculture, logistics, etc.

The theoretical description of spatial processes allowed to develop the empirical analysis of house prices in relation to their geographical location. An increase of spatial studies on housing prices has been observed especially in the last few years. In the next part of this chapter I focus on some researches that are closely related to approach presented in this article.

Martínez and Lorenzo (1999) used kriging method to estimate a spatial process as a linear combination of observations in a space. To model the spatial behaviour of housing prices in Albacete, Spain they used four methods of estimation: universal point kriging, ordinary kriging on the residuals of a generalized additive model for the point estimation, universal block kriging and median polish kriging for the block estimation. They concluded that they prefer blocks methods, as a regular grid that covers the city is created and observations in such grid blocks are averaged. But the best results in terms of cross-validation and total error of prediction provided median polish kriging.

Anselin and Le Gallo (2006) compared the results of: using different interpolation techniques, the inclusion of air quality in the model, and applying various estimation methods in hedonic housing prices models in Southern California. They claimed that hedonic estimates of pollution are sensitive to the interpolation technique used. They find out that kriging method provided the best results in terms of estimates, interpretation and model fit.

Chica-Olmo (2007) compares the results of three methods: kriging methods, isotopic data cokriging, and heterotopic data cokriging methods in Granada, Spain. He used a multivariate spatial method that takes into account the variable of interest and auxiliary correlated variables to estimate and interpolate housing prices. The housing prices may be estimated as a combination of house prices and structural characteristics in a continuous space and it allows to create house price maps. The results of this study shows that cokriging gives better results than kriging methods. Chica-Olmo suggests that using the cokriging method can be considered for mass appraisals.

Montero and Larraz (2011) aimed at comparing the various estimates of commercial establishment prices with the use of methods based on: inverse distance weighting, 2-D shape functions for triangles, kriging, and cokriging. It appeared that to estimate commercial property prices in Toledo, Spain, auxiliary stochastic processes correlated with the prices of commercial real estate were needed, as the sample size was too small. The results showed that kriging improves the classical interpolation techniques and that cokriging (auxiliary variables) has an advantage over kriging. The correlation between the prices of different types of real estate (houses and commercial establishments) allows to obtain more accurate predictions.

Lately, spatial modeling of housing market in Poland has started to develop, as we can observe more and more articles on that topic. In many articles different spatial econometric methods are used to analyze housing prices in Polish cities (see Kulczycki et al. (2007) – geographically weighted regression, Branna et al. (2012) – compares few methods, geographically weighted regression, hedonic model estimated by ordinary least squares (OLS) containing some spatial variables, Waszczuk (2013) used the spatial lag model (SLM), the spatial error model (SEM) and the geographically weighted regression (GWR)).

In recent years it can be observed that more researchers in Poland use geostatistical methods to calculate prices that are continuous in space. Cellmer in 2011 performed analyzes that stressed usefulness of selected geostatistical methods in studying the effect of environmental factors on real estate prices. He used GWR model to assess the local impact of noise effects on prices. Then by applying co-kriging methods average prices were interpolated and presented on maps of average real estate prices. Cichociński (2011) summarized that most of the deterministic methods were characterized by a relatively high average error. The best results were given by the kriging method, probably as it takes into account both local specificity, as well as global trends. Chrzanowska (2013) in her study used two geostatistical methods – Kriging and Inverse distance weighting (IDW) – to analyze real estate prices in Warsaw. She stated that kriging is a more useful method as it allowed for more precise prediction of the prices presented on the map. Walacik et al. (2013) used a few methods of estimating values of real estate: geographically weighted regression, spatial autoregressive models, regression-kriging (RK). They analyzed prices in Olsztyn. The RK method gave comparable results to other methods, so the authors conclude that RK models are not always significantly better than other, more spatial methods. Całka and Bielecka in 2014, after taking account non-spatial characteristics such as: type of market, standard of apartments, storey and the year of construction, interpolated the value of the housing units in Siedlce by using ordinary kriging method. Garguła and Zając (2016) analyzed an influence of spatial factors on the behavior of housing purchasers in Bytom. In their study they used three different methods of interpolation: Inverse Distance Weighted Interpolation (IDW), Radial Basis Functions (RBF) and Ordinary Kriging. The Ordinary kriging method gave better results than other methods in terms of average errors.

The lack of data about housing units and their detail localization or difficult access to that information causes, that the development of spatial modeling of Polish housing markets is slow. As a results much research is based on an incomplete information, so the outcome reflects only a part of housing market variability.

2. Methodology

In the reviewed literature used and recommended most commonly are two interpolation methods: Inverse distance weighting (IDW) and Ordinary kriging (OK). These methods are based on distance spatial autocorrelation principle – the closer the observations are, the more similar their values are. The predicted value of the observation not included in the sample is calculated on the basis of nearby observations and higher weights are given to points that are closer to the predicted observation. IDW method uses exponential weighting scheme according to distance, whereas in the case of OK variogram has to be created to model spatial data autocorrelation and assign weights. It usually allows to obtain better interpolations; but it is more time consuming and demands a lot of subjective decisions. Both methods use a determined number of observations to calculate predictions nearby the estimated point.

Inverse distance weighted interpolation

The Inverse distance weighting (IDW) is a convex interpolation method which uses the continuous model of spatial variation. It calculates the values of every point in a space using a weighted combination of observations from nearby points. The weighting scheme of IDW method can be expressed (see Johnston, Ver Hoef, Krivoruchko, and Lucas, 2001) as:

$$\hat{z}(S_0) = \sum_{i=1}^{N} \lambda_i (S_0) z(S_i),$$

$$\lambda_i(S_0)=\frac{\left(\frac{1}{d(S_0,S_i)}\right)^p}{\sum_{j=1}^{N}\left(\frac{1}{d(S_0,S_i)}\right)^p};\quad i=1,\ldots N,$$

where:
$\lambda_i(S_0)$ weights assigned to the sampled observations,
$d(S_0,S_i)$ – the Euclidean distances between the sampled locations and points with unknown value,
N – the sample size,
p – the exponent that impacts weighting scheme (p=2).

Kriging methods

Kriging is an interpolation method that uses housing prices z (Si) at location Si to estimate the values z (S_0) at a point S_0 where the observation does not exist. 'Z' is the random variable and it can be written as the sum of a deterministic components: the trend (m (x)), and a stochastic error component (r (x)) at any location.

Similarly to IDW, this technique gives higher weight to points that are located closer to the analyzed points. This variogram expresses the spatial dependence between housing prices at different distances. The weights, unlike in IDW are determined based on a semivariogram, which is calculated using a semivariance estimator (see Basu and Thibodeau 1998, Cellmer 2010):

$$\gamma(H)=\frac{1}{2n}\sum_{i=1}^{n}\left(z(s_i+h)-z(s_i)\right)^2,$$

where:
Z(s_i + h), Z(s_i) – the value of the analyzed parameter at points at h distance,
n – the number of pairs of points at h distance.

The structure of variance of values in a data set is described by the semivariance value determined by distance h. After mapping those values on the diagram (experimental semivariogram) the best theoretical semivariogram function should be chosen. Commonly used theoretical models are: spherical, exponential and a Gaussian model[2].

2 In this study spherical variogram is applied. It is attached in an Appendix.

Detailed descriptions of kriging methods can be found in Goovaerts (1997). All these interpolation methods can be implemented in R, in the gstat package (Pebesma and Wesseling, 1998; Pebesma, 2004). For completeness, brief descriptions of these kriging methods are provided below.

Ordinary Kriging

Ordinary kriging (OK) provides the best linear unbiased (BLUE) estimators of the value of the analyzed variable, basing on the location of observed values in a neighborhood. It can be expressed as follows:

$$\hat{z}_{ok}\left(x_0\right)=\sum_{i=1}^{n}\lambda_i z(x_i),$$

$$\sum_{i=1}^{n}\lambda_i=1,$$

where:
$\hat{z}_{ok}\left(x_0\right)$ – is the estimated housing price at the non-sampled location x_0,
$z(x_i)$ – is the measured housing price at the x_i point,
λ_i – is the weighting factor for $z(x_i)$.

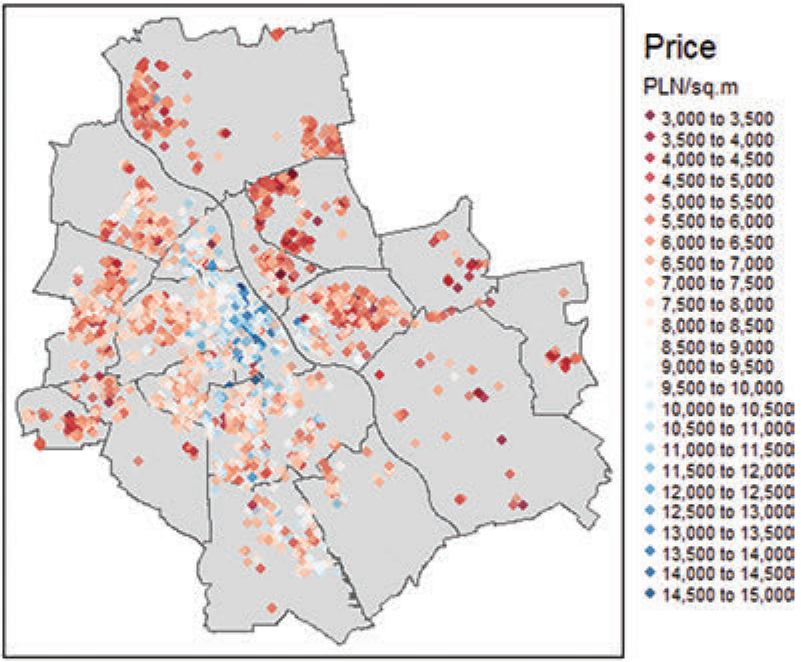
3. Empirical results

In order to conduct such a comprehensive survey I had to combine data from several sources: the register of prices and values (RCIWN[3]) and national geodetic and cartographic sources. On the basis of available datasets I have built a housing database. Research uses information about transactions from the existing housing stock. The next step was to clear the data set and reject outliers[4]. Then, the observations were geocoded (the latitude and longitude coordinates are determined). The final data set consisted of 3,955 transactions concluded from Q1 2016 to Q6 2016 in Warsaw.

[3] The register of prices and values (RCIWN) is a database containing the prices designated in notary deeds and the real estate values (property valuers appraisals).

[4] The distributions of prices and areas of housing were analyzed. On the basis of graphs observations with price per sq. m lower than 3,000 or higher than 15,000 (217 observations) and with usable area lower than 15 sq. m or higher than 150 sq. m were deleted.

Figure 1. Map of housing prices in Warsaw



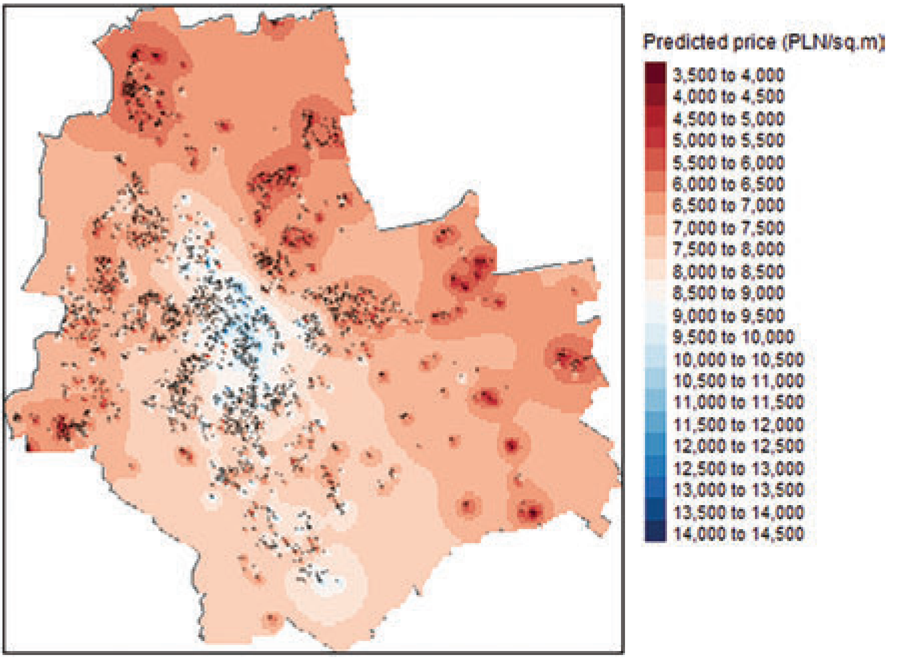
Source: Own calculation based on RCiWN.

This analysis focuses on the Warsaw housing market as it is Poland's biggest and is an important economic center of Poland and Central Europe. The city is separated by the Vistula river, which hinders the free flow of people between both sides.

After the Second World War a large amount of the housing stock in Warsaw was destroyed. Under the socialistic system the major problem was to satisfy housing needs, as the system was inefficient. After 1990 the cooperatives constructed slightly better housing then in 1945–1990. New city districts were developed and transport links with existing ones were improved. The role of housing cooperatives diminished after 2004, when Poland joined the European Union. A professional primary market was established and a housing finance system developed. The financing of housing with loans remains the domain of large cities, while in smaller towns and the countryside most purchases are made with savings and mortgages are used to close funding gaps. Dwellings in Warsaw that were built between 1945 and today are very heterogenous in terms of quality, design and location, especially transport links. An important fact is that most housing construction between the 1950's and 1960's took place in the city center and the surrounding areas, thus even though the dwelling is of low quality, its locational advantage makes it expensive. All the heterogeneity in quality calls for a hedonic price analysis that takes the geospatial dependence into account.

Figures 2 and 3 present the results of IDW and OK methods. As a result we received continuous maps that may be used by valuers to assess property price in every location. We can see that both methods produce similar outcomes, but OK method gave more realistic results, especially in the areas where there is a small number of observations. This study should be developed in the future and the strong assumptions, on which the methods used in the article base, should be partly revoked. The future studies should use more advanced interpolation methods such as, among others, universal kriging[5] and co-kriging where auxiliary variables are taken into account to better explain housing prices.

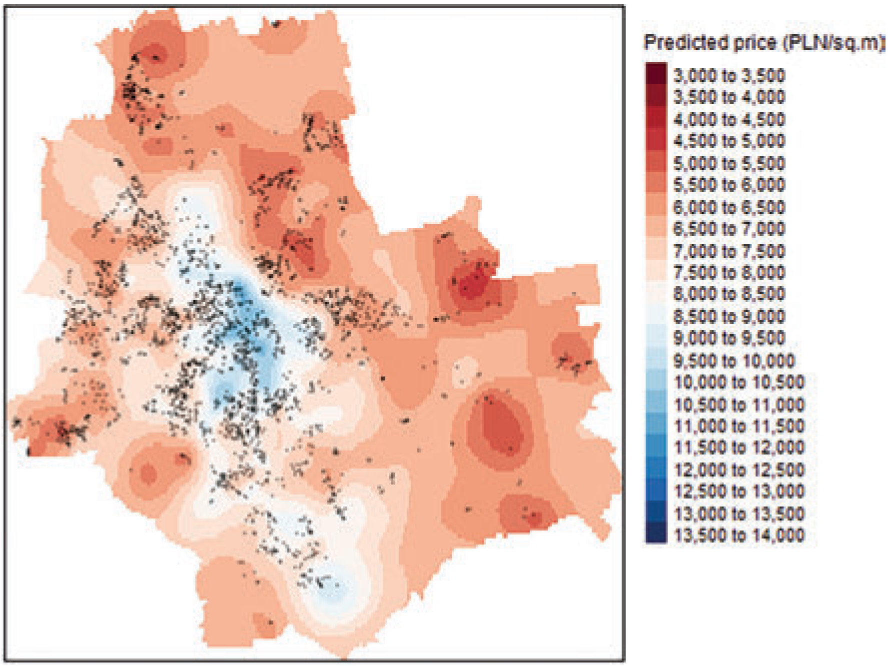
Figure 2. Map of housing prices interpolated using IDW in Warsaw



Source: Own calculation based on RCiWN.

[5] UK is also known as kriging with a trend or kriging with a drift. Spatial trend or a drift represents any tendency for the values to change as a function of the coordinate variables.

Figure 3. Map of housing prices interpolated using OK in Warsaw



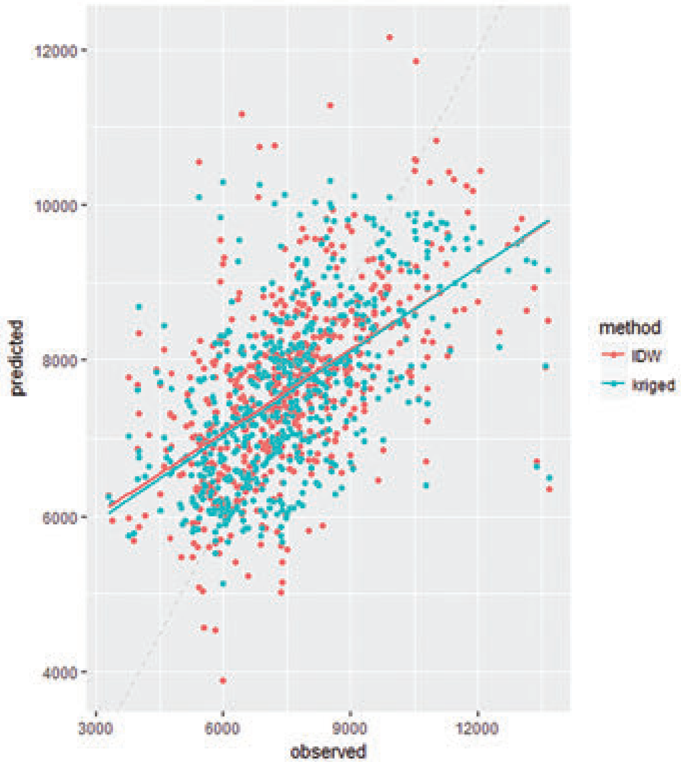
Source: Own calculation based on RCiWN.

Choosing the proper method for estimation of reserve with a minimum error is very important in geostatistical operations in mining engineering.

Choosing the proper method for estimation and receiving a minimum valuation error is very important in in the case of property price valuation. In order to compare these two methods valuation dataset was used. The next step was to clear the data set and reject outliers[6]. The final dataset consisted of 575 transactions concluded in July 2017. On the basis of Figure 4 it can be concluded that ordinary kriging provides slightly better results, as residuals (predicted values vs. observed ones) of that method are lower.

6 The distributions of prices and areas of housing were analyzed. On the basis of graphs observations with price per sq. m lower than 3,000 or higher than 15,000 and with usable area lower than 15 sq. m or higher than 150 sq. m were deleted.

Figure 4. Predicted values of housing prices vs. observed values



Source: Own calculation based on RCiWN.

Conclusions

The aim of this article was to demonstrate and compare the results of different geostatistical methods on the example of Warsaw housing market. This study suggests that interpolation methods may be useful for conducting mass appraisals. Another important application is the calculation of real estate price change indices. Moreover, such an analysis has a great scientific significance as a study of the spatial distribution of property prices and it gives possibility to create continuous maps of property values with an overall view of pricing. Two methods of interpolation were presented and compared. The results showed that ordinary kriging provides slightly better results than inverse distance weighting.

The methodology applied in this study offers a unique understanding of spatial aspects and relationships of the housing market. This is very important, as it gives a hint about buyers' choices, preferences and the evolution of urban spatial structure. The future studies should use more advanced interpolation methods such as, among others, universal kriging and co-kriging where auxiliary variables are taken into account to better explain housing prices. The continuation of such research on housing policy and urban planning should be the subject of ongoing and future studies.

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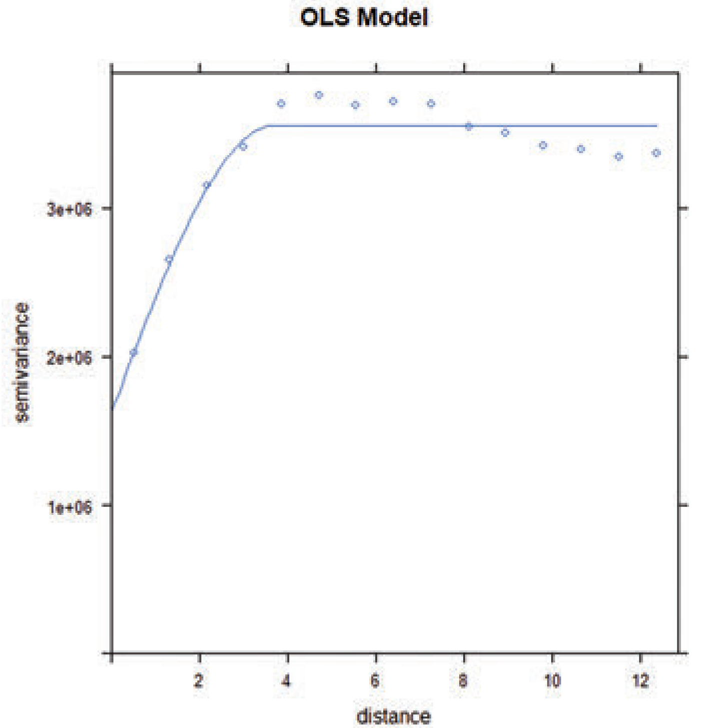
Appendix

Figure 1. Fitting theorethical variogram



Source: Own calculation on the basis of RCiWN.

Chapter 13

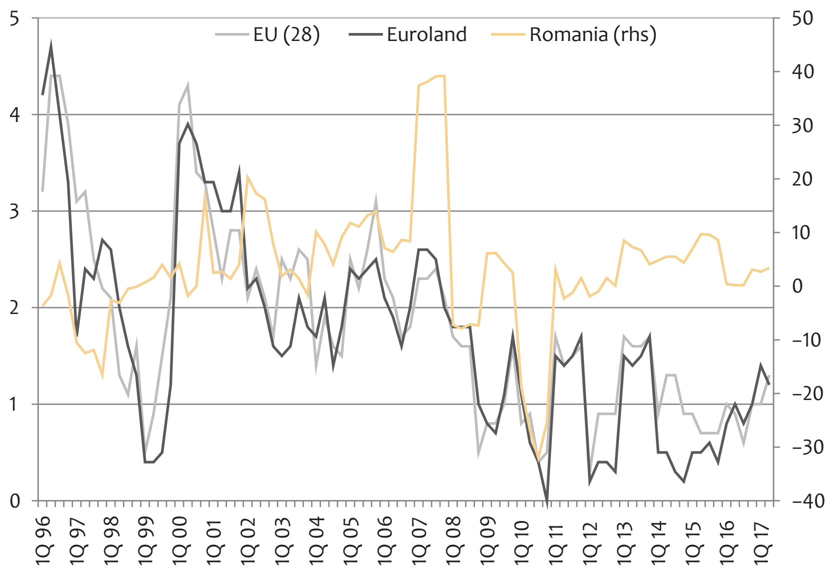
The housing prices in Romania – recent developments

Andrei Radulescu[1]

Introduction

The real estate market is the fourth largest sector in the Romanian economy, with a contribution of around 8.5% in 1H 2017, a level below the averages in the European Union (10.1%) and Euroland (10.3%), according to Eurostat database.

Figure 1. The value added within the real estate sector (%, YoY, unadjusted)



Source: Eurostat database, September 2017.

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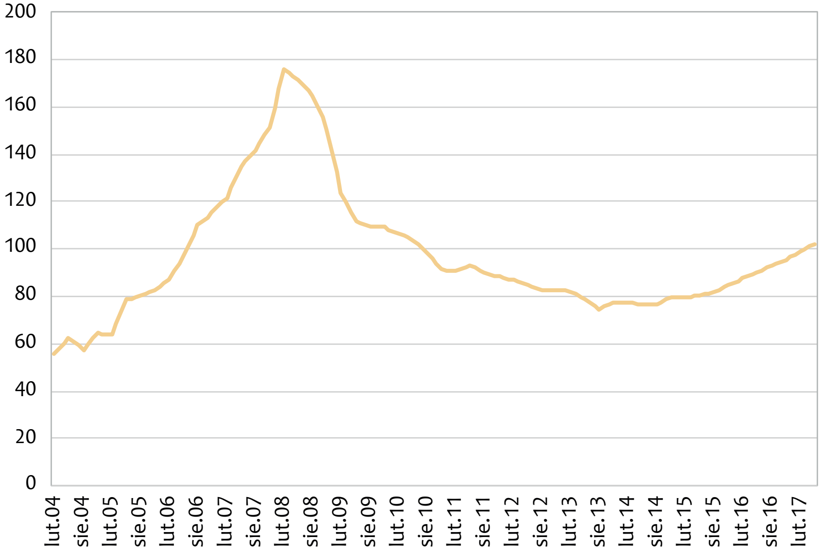
It is worth mentioning that this sector entered the post-crisis cycle at the end of 2012, after almost four years of contraction, as can be noticed from Figure 1. This evolution was supported by the post-crisis cycle in the global industry, the expansion of the supermarkets' chains and the re-launch of the residential market.

It should be noted that the latest component of the real estate market entered the post-crisis cycle in 2014, under the influence of the First House Program, the improvement of the real disposable income of the population and the decline of the real financing costs.

The First House Program was an important catalyst for the residential market (over 200,000 loans since its inception, according to the statistics of the National Bank of Romania). Within this Program the Government guarantees 50% of the loan, the advance is established at 5%, while the interest rate is capped: 3M ROBOR + 2.5 p.p. This program was introduced by the Government eight years ago in order to support the residential construction, severely affected by the incidence of the Great Recession.

As follows from Figure 2, the recovery of the residential market is reflected by the dynamics of the average prices which returned in 2017 to the levels from 2010 (the data from Imobiliare.ro).

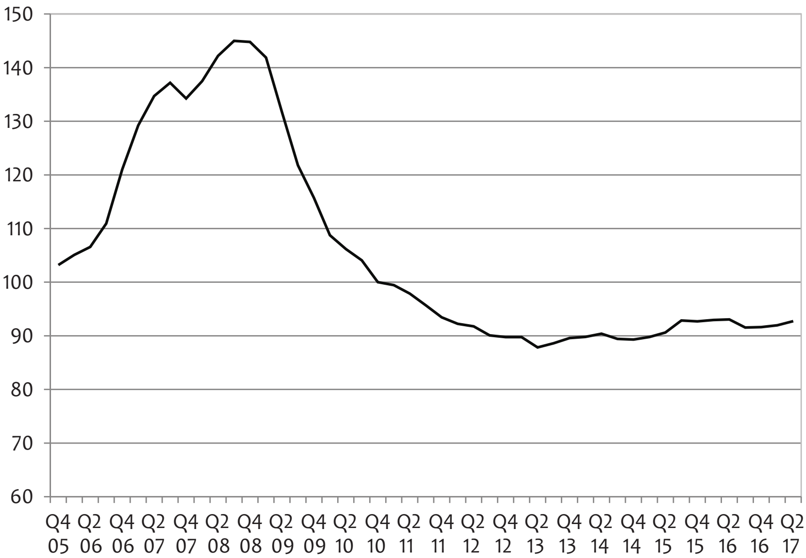
Figure 2. The nationwide house price index in Romania (2010 = 100)



Source: www.imobiliare.ro, September 2017.

At the same time, the recovery of the residential market is also confirmed by the stabilization of the permits number, as can be noticed from Figure 3. This indicator rose by 3.8% YoY in 2015, after contracting for six years in a row. It adjusted by 1.2% YoY in 2016, but returned to growth in 1H2017 (2.5% YoY).

Figure 3. The residential permits index in Romania



Source: The Statistics Office Romania, September 2017.

In this paper we analyze the relations between the housing market and the real economy in Romania during 2009–2017, by employing traditional econometric tools and the Eurostat database.

The rest of the paper has the following structure: the methodology is briefly described in the next chapter; the interpretation of the results is realized in the third chapter; the last chapter presents the main conclusions.

1. Methodology

In order to analyze the connections between the residential market and the real economy we estimate several equations.

On the one hand, we try to identify the factors that determine the evolution of the residential prices. In this context, we employ the Hodrick–Prescott filter in order to estimate the trend components for the houses prices, the real interest rate, the real wages and the EU residential prices.

The Hodrick-Prescott filter is one of the econometric tools used in order to distinguish between the structural and cyclical components of the economic indicators. This filter is based on the following mathematic expression:

$$\text{Min}\sum_{t=1}^{T}(Y_t - Y_t^*)^2 + \lambda\sum_{t=2}^{T-1}\left((Y_{t+1}^* - Y_t^*) - (Y_t^* - Y_{t-1}^*)\right)^2 \qquad \textbf{(1)}$$

where Y_t, Y^*_t and λ represent the indicator, the structural component of the indicator and a smoothness parameter. In this paper we consider a value of 1,600 for the parameter λ, a level similar with that suggested by Hodrick-Prescott for the quarterly data.

On the other hand, we estimate the impact of the housing prices on the dynamics of the private consumption (the main component of the GDP) in order to analyze the so-called wealth effect.

In this context, the estimated equations were:

$$\begin{aligned}&\text{TRENDPRICES} = \text{C}(1) * \text{TRENDREALINTERESTRATE} +\\ &+ \text{C}(2) * \text{TRENDEUPRICES} + \text{C}(3) * \text{TRENDREALWAGES}\end{aligned} \qquad (2)$$

in which:
TRENDPRICES = the trend component for the housing prices in Romania,
TRENDREALINTERESTRATE = the trend component for the real interest rate,
TRENDEUPRICES = the trend component for the EU housing prices,
TRENDREALWAGES = the trend component for the real wages in Romania.

In order to assess the impact of the housing prices on the private consumption, the following equation was estimated:

$$\begin{aligned}&\text{TRENDPRIVATECONSUMPTION} = \text{C}(1) * \text{TRENDPRICES} +\\ &\qquad + \text{C}(2) * \text{TRENDREALWAGES}\end{aligned} \qquad (3),$$

where
TRENDPRIVATECONSUMPTION = the trend for the private consumption in Romania,
TRENDPRICES = the trend for the housing prices in Romania,
TRENDREALWAGES = the trend for the real wages in Romania.

In this paper we use the quarterly statistics from Eurostat, National Institute of Statistics and National Bank of Romania databases for the period 1Q1999–1Q2017 and the E-Views econometric software.

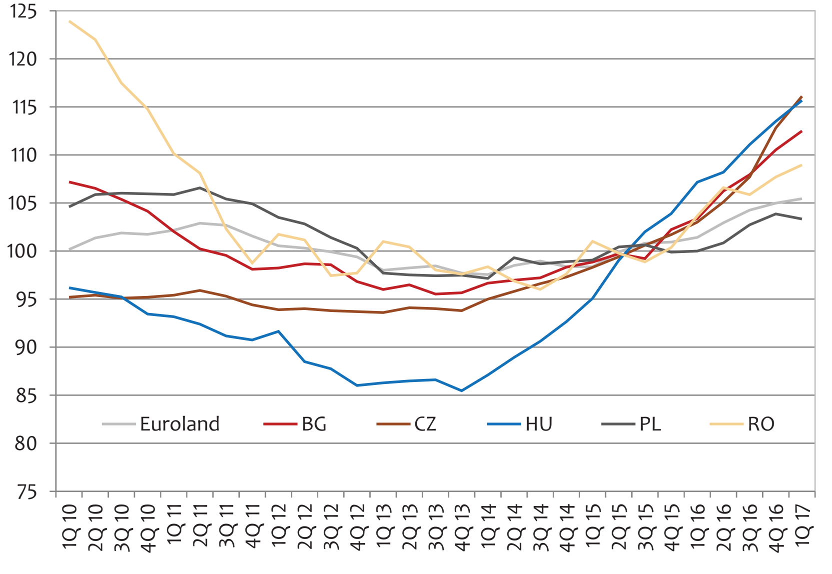
2. Results

After estimating the equation (2) it results that the trend of the residential prices in Romania is positively correlated with the trend of the EU housing prices and the trend of real wages in Romania and negatively correlated with the real interest rate in Romania.

The R-squared indicator is very high, around 97%. At the same time, the estimates show that the trend of the housing prices in Romania is more dependent on the EU trend for housing prices than on the trend for real wages.

This result (also reflected in the Figure 4) should not surprise in our view, given the strong integration (economic and financial) of Romanian economy with the European Union. A positive momentum in the European economy has spill-over impact for Romania, leading to a higher confidence and new capital flows (including remittances).

Figure 4. The housing prices index in the European Union and CEE



Source: Eurostat, September 2017.

As can be seen from Figure 4 Romania was the CEE country that presented the most severe decline of the housing prices during the Great Recession, an evolution determined by the strong overvaluation level during 2008 and the capital outflows starting that year.

At the same time, the recovery pace of the housing prices in Romania was lower compared with several CEE countries (Hungary, Czech Republic and Bulgaria) over the past quarters.

It is important to point out that the negative coefficient for the TRENDREALINTERESTRATE is normal, as the higher the real financing costs, the lower the demand for houses, especially in Romania, where the Government has supported the residential markets since the incidence of the Great Recession through the First House Program.

Similar results are obtained by estimating the following equation:

$$\text{PRICES} = C(2) * \text{REALINTERESTRATE} + C(3) * \text{REALWAGES} + \\ + C(4) * \text{EUPRICES} \tag{4}$$

in which
PRICES = the housing prices in Romania,
REALINTERESTRATE = the real interest rate in Romania,
REALWAGES = the real wages in Romania,
EUPRICES = the housing prices in EU.

However, compared with the previous results the R-squared is lower, around 64.

Last, but not least, the results of estimating equation (3) show the trend of the private consumption in Romania is more dependent on the trend for the housing prices than on the trend of the real wages.

This is the so-called *wealth effect*, as the evolution of the housing prices is a barometer for the confidence of the population, especially in Romania where most of the households own their houses.

In other words, the increase of the residential prices contributes to a higher wealth perception, leading to a stronger consumption.

3. Conclusions

To sum up, the results of the analysis are in line with the economic theory, according to which there is a negative dependence of the housing prices on the real interest rate. In this context, we point out that the expected post-crisis monetary cycle (signaled by the National Bank of Romania) will impact the residential market in the following quarters.

At the same time, the housing prices in a region integrated in an economic space are very dependent on the trend of the prices in that space. Taking into account this result, we underline that the maturity phase of the EU post-crisis cycle (and the exit of the European Central Bank from the unprecedented expansionary monetary policy) may interrupt the upward trend of the housing prices in Romania in 2018.

Furthermore, the recovery of the residential prices contributed to the strong dynamics of the private consumption recently: YoY growth paces converging to the pre-crisis levels.

On the other hand, the recent evolution of the housing prices in Romania represents a risk for the mid-run macro-financial stability of the country. In this context, the expected increase of the monetary policy rate (within the recently signaled post-crisis monetary cycle) and its impact on the financing costs may lead to the increase of the non-performing loans. At the same time, a change of the trend for the housing prices in the future corroborated with the continuity of the migration trend for the active population and with the intensification of the twin deficits in Romania may trigger the end of the post-crisis cycle in the real economy earlier than anticipated.

This paper is a starting point for studying the relation between the residential prices and the real economy. This research could be developed in the future, by comparing the dynamics in several EU countries and considering new indicators in our equations as well as by analyzing the polarization effect.

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Chapter 14

Financial soundness of Lithuanian households and the stability of the financial sector

Virgilijus Rutkauskas[1], *Darius Kulikauskas*[2], *Vaidotas Šumskis*[3]

Introduction

Financial position of households was directly affected by the asset price dynamics that was fueled by excessive credit growth prior to the financial crisis in the end of the last decade. Moreover, consequences of the financial crisis like increased unemployment and shrinking income led to further deterioration of the financial soundness of households and probability to default on household debt accumulated during a pre-crisis economic expansion has risen substantially. The deterioration in household finances has since encouraged numerous empirical studies and scientific discussions about the impact of households on the stability of the financial sector. However, households, as a potential source of risk to the financial sector, have been already attracting interest from academics monitoring their growing debt. Scandinavian banking crisis in 1991–1993 has led to a reconsideration of the prevailing stance that households bear low credit risk.

Before 2007, the global credit growth was mainly attributed to rapid economic development, improving expectations of enterprises and households, growing income and low interest rates complemented with favorable lending conditions. Surging private sector debt enabled banks to increase their loan portfolios, compete for the most favorable lending conditions to be offered to their customers, but did not always pay sufficient attention to the pro-cyclicality of the banking sector's development and the associated changes in credit risk profile. Household

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indebtedness in Lithuania grew more rapidly during 2003–2008 economic boom than indebtedness of other sectors of the economy.

Credit institutions usually take a certain amount of credit risk by extending loans to households. While a single household accounts for only a marginal share of the credit risk borne by the institution and the whole loan portfolio is sufficiently diversified, the lenders are not protected against larger losses which may arise due to economic shocks that adversely affect the financial position of households. This kind of threat was also one of the key reasons why, following the aftermath of recent financial crisis, many of the developed countries have set up authorities responsible for monitoring the risks to the financial system, analyzing and applying risk management measures. Thus, the implementation of macroprudential policies is one of the means to reduce the likelihood of the formation of financial market imbalances and to mitigate the negative effects of disproportionate credit expansion.

The aim of this paper is to explore the transmission mechanism of selected economic shocks (interest and unemployment rates, disposable income, housing prices) to the country's financial system. It examines how these shocks will change the ability of households with a mortgage to meet their financial obligations and how this would affect the quality of bank loan portfolios and capital adequacy ratios. The research is based on analysis of household financial margins – income less the cost of living and repayment of a loan (balance repayment and interest).

The article, without introduction and conclusions, consists of three parts. The first part provides an overview of similar studies in other countries, the second one – the data used for this research, the assumptions made in it and the methods chosen to be used. The third part describes the testing methodology used to investigate the financial vulnerability of households having loans for house purchase, and presents the results of household risk assessment.

1. Literature on resilience of households with loans to various economic shocks

In the first decade of this century, household indebtedness grew in many parts of the world. On the one hand, it had a significant impact on aggregate demand growth and economic development; on the other hand, doubts were raised about how much households were able to meet their financial obligations without a threat of default. Such doubts fostered discussions on how to measure the soundness or vulnerability of households' financial position and attracted academic interest to explore the methods measuring it.

Financial vulnerability of households depends on several factors: indebtedness, income, expenditure structure, interest rates, loan contract conditions. Some academic works have shown that financial vulnerability also depends on the size of the household: the least vulnerable is the household consisting of two employed people, whereas the most vulnerable is the one with children and other unemployed persons (La Cava &simon, 2003; Bowie-Cairns & Pryce, 2005). These studies also revealed more characteristics of households, which determine the probability of experiencing financial difficulties and cause damage to the creditor, such as household savings and family status.

Empirical research based on micro-level household data is a relatively new academic trend. Consequently, there are few examples of such studies. The Riksbank, central bank in Sweden, published a study that investigates household indebtedness and solvency by employing a micro-data set (Johansson & Persson, 2006). This work tests how would the household income (less the debt service and living expenses) change in an event of unlikely but possible economic developments, such as an increase in interest or unemployment rate. This paper explores the ability of households to properly meet their financial obligations. Swedish households are found to be sufficiently resistant to severe economic shocks, largely due to their high income and a significant cushion of accumulated assets.

Norges Bank also conducted a similar micro-data research of Norwegian households' financial margins in a period between 1987 and 2004 (Vatne, 2006). Analysis of the distribution of financial margins by household groups has made it possible to determine which group is least protected in the event of economic shocks. The study finds that high indebtedness in Norway does not lead to high credit risk, as the loans are concentrated among high income households.

Fuenzalida and Ruiz-Tagle (2009) assess the probability for Chilean households to default in the context of adverse macroeconomic conditions. The most pronounced source of household default risk is attributed to a decrease in income after the loss of job. As a result, the unemployment shock is the main focus in this study. Panel data and Monte Carlo method are employed to examine the level of risk stemming from households to the whole financial system. The work concludes that the unemployment shocks do not lead to a significant default risk of Chilean households as the majority of debt is accumulated by households less sensitive to income fluctuations.

Studies that investigate households from multiple countries have also been carried out. For example, World Bank has examined the impact of shocks in credit availability, income, food and fuel prices to households from European and Central Asian countries (Tiongson et al., 2010). The household sensitivity to these shocks is measured by changes in their debt service burden, real income and the number of households below the poverty line after the shock. The results of the research suggest that, after the shocks, the number of households that cannot meet their financial obligations is significantly higher in low income countries.

To the extent of the authors' knowledge, the above-mentioned World Bank study was the first academic paper which investigated the resilience of Lithuanian households to potential economic shocks. This study used data from Household Income and Living Conditions Survey and Household Budget Survey. On the other hand, financial position of Lithuanian households has not been explored by employing granular micro-level data covering all households with loans. As a result, this study is the first research which employs micro-level data to test the financial resilience of Lithuanian households to various economic shocks.

2. Data, methodology and assumptions

This study employs data from the Household Financial Monitoring Information System (HFMIS). This system was developed by the Bank of Lithuania in 2011 and it links several databases – loan level credit registry from the banks operating in Lithuania, households register and the Lithuanian Social Insurance Authority (SIA) database that provides the data of employed persons' salaries before income tax. A household is considered to be a natural person, spouse (if the person is married) and children under the age of eighteen.

HFMIS data include mortgages that have been extended to households since 2003. Nevertheless, only the latest data of Q2 2017 were employed in the research as it did not intend to reveal dynamics of the financial position of households. The micro-level data set used in this study had records of 171.1 thousand Lithuanian households that had unpaid mortgages at the time. This number of households was equal to 12.3% of all households in Lithuania[4], and the value of their loans for house purchase totaled 7.0 billion EUR while other loans owed to financial institutions equaled 0.3 billion EUR. Average mortgage in the data set amounted to 40.8 thousand EUR. On average, one adult household member earned gross income of 1 040 EUR[5], spent 190 EUR on mortgage repayment and

[4] According to Eurostat data for 2016.

[5] Micro-level data contained records of households that did not have any income reported to the SIA or their earnings were lower than minimum living needs. Although it was not possible to determine if these households were unemployed, most of them met their financial obligations on time, meaning they were not stretched financially and most likely had another source of income than insured income or

76 EUR[6] on other debt repayment costs per month. At the same time, minimum monthly living expenses consisted 427 EUR per household.

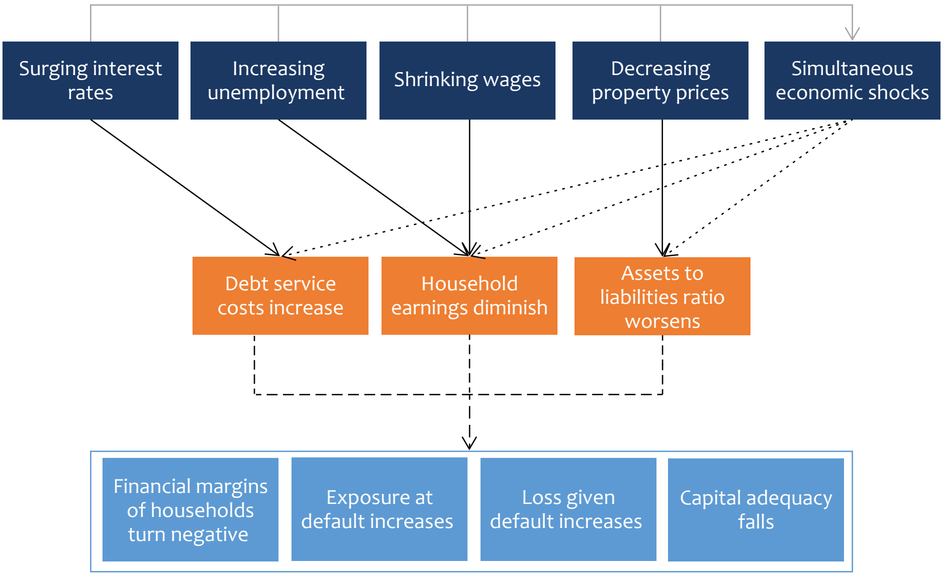
Nevertheless, HFMIS does not cover all the data needed to conduct household stress testing. Therefore, some assumptions have to be made and taken into account when evaluating the results of the study. HFMIS only collects data of insured income, from which mandatory social insurance contributions have to be paid, as well as state social insurance and unemployment benefits. However, social insurance contributions are not deducted from other types of household income as households can also receive income from shadow activities, capital income, remittances, etc. Moreover, expenses of debt balance and interest payments are not reported in full for the households that obtained a credit during the latest time period in the data set, in this case it is Q2 2017. Besides, it is a common practice for banks to postpone balance repayments of the newly issued mortgage for some period of time, indicating that full expenses for such households would be reported to the HFMIS after few quarters. In such cases it is assumed that mortgages would be repaid in full after twenty five years, while other loans – in five years, and debt service expenses of such households are modified accordingly. Another caveat that plagues micro-level database is unsustainably large debt repayment costs, sometimes exceeding a third of all remaining loan balance and observed mostly in cases of credit card, leasing and consumer debt. Thus, in this study it is assumed that household expenditures on remaining debt cannot exceed a quarter of a total remaining balance. As a result, debt service costs are modified for such households that exceeded this threshold in Q2 2017.

Household expenses include loan repayment costs (loan balance and interest) and necessary living expenses. Living costs are not differentiated according to the geographic location where the households live. Instead, the poverty threshold published by the Statistics Lithuania is considered as a proxy of living expenses presuming that living expenses of two or more adults in one household constitute 200% while that of a single person – 300% of the estimated poverty threshold. Consequently, the financial margin is determined for every household in a data set when summarizing its income, loan repayment costs and living expenses.

social benefits that were reported by the SIA. In such a case the authors assumed that if a household did not have sufficient income to cover minimum living costs but at the same time repaid all its loans on time, income of adult members of such a household would be equal to average income per adult household member. On the contrary, if a household delays its debt payments, it is assumed that all its members are unemployed and their gross income is as equal to minimum unemployment benefit defined by the SIA of 228 EUR per month for every adult person.

6 For those households who had other financial obligations than a loan for house purchase.

Chart 1. Impact scheme of economic shocks



Source: compiled by authors.

Based on the studies of the World Bank and Swedish and Norwegian central banks, this paper investigates an impact of certain economic shocks, such as steep interest rate increase, rising unemployment, decreasing salaries and falling property prices, on households' financial position and, at the same time, on financial system. As can be seen from the scheme outlined in Chart 1 these shocks affect households by lowering their income (disposable income and unemployment shocks) or increasing their loan repayment costs (interest rate shock), or by decreasing the value of their housing assets (property price shock). In addition, financial position of households may be exposed through all channels simultaneously as earnings, unemployment, interest rates and housing price shocks may materialize at one time. Financial margins are negatively affected by these shocks thus households are unable to meet their financial obligations to banks. The quality of the banks' housing loan portfolio (measured by exposure at default) changes accordingly and when the value of pledged real estate assets of households with negative financial margins falls below the value of their financial liabilities, banks and the entire banking system are losing money in an event of such a households' default. Banks usually cover the losses with their capital, thus the deterioration of the financial position of households affects the banks' capital adequacy ratios. According to the latest Bank of Lithuania data, at the end of 2015 the assets of banks operating in Lithuania accounted for 79.2% of the total assets of the financial system; therefore, in an event of economic shocks a deterioration of households' financial position would have a significant impact on the whole financial system and its stability.

When examining the resilience of households to economic shocks, it is assumed that the shock affects the household as soon as it happens. In reality, economic shock usually does not affect households immediately, but strengthens gradually. For example, when economy starts to contract, unemployment rate increases for several quarters in a row, and households are not losing their jobs all at once. Another assumption made in analysis is that the household cannot change the terms of the loan (currency, repayment period, bank's margin). Such a tightening of conditions is justified by the purpose of the study to investigate the impact of households' financial condition on the stability of the financial system in the event of an economic stress.

Sensitivity test of the single household financial margin allows to determine the effect of an economic shock on the financial position of each household. Free income balance for each household is calculated as follows:

$$M_i = DI_i - CL_i - CF_i - CI_i, \tag{1}$$

where M – free household income (financial margin), DI – disposable income (salary), CL – living expenses, CF – loan balance repayment, CI – loan interest repayment. An estimate of the financial margin indicates whether the household faces the risk of a default. It is assumed that a negative margin estimate indicates that household cannot properly meet its financial obligations. However, the results obtained from the micro data analysis of Lithuanian households should be treated with caution, as in Q2 2017 financial margin was negative for 8.6% of households with mortgage loans, although just 2.0% of mortgages in the data set were non-performing. This discrepancy in the data set most likely arises due to the aforementioned deficiencies in household earnings data as households may earn more than income reported to the SIA.

Potential losses to be incurred by banks on their mortgage portfolio are estimated as difference between the value of pledged real estate assets held by households whose financial margins were negative as of Q2 2017, and their liabilities. In calculating this difference, a home of a household is considered to be the only collateral pledged, and the value of which is indicated in the HFMIS. Such an assumption does not reflect the total value of household's assets, such as financial assets, which may be used when the financial position of a household deteriorates. Household obligations reported by HFMIS include not only mortgage loans, but other borrowings from banks and other financial institutions as well (consumer and credit card loans, leasing, etc.).

Therefore, potential losses are calculated as:

$$EL = \sum_{i=1}^{N} \left[I_i^M \left(-NW_i \right) \right], \tag{2}$$

where EL – expected loss, I^M – indicator for a household's financial margin, equal to 1 if the margin is negative and the value of pledged real estate is lower than remaining balance of a mortgage, and equal to 0 if the margin is positive or pledged real estate value is higher than the mortgage balance, NW – difference between pledged real estate value and total credit obtained by a household.

Three ratios are derived to evaluate the impact of a change in financial position of households with mortgages after the economic shocks:

1) The share of households with mortgages, whose financial margin is negative, in a total sample of all households with loans for house purchase. This indicator enables to determine the change in a share of financially stretched households during economic shocks;
2) Exposure at Default (EAD), indicating a share of credit obtained by households with mortgages, financial margin of which is negative, in a total credit of all households that have a loan for house purchase;
3) Loss Given Default (LGD), portraying a share of uncovered value of loans owed by the households with negative financial margins in banks' loan portfolio.

While an increase in the unemployment rate does not proportionally affect all households with loans, the impact of this shock is estimated by applying the Monte Carlo method, allowing the average impact of shock to be evaluated through repeated experiments. The probability to lose a job during a shock is assumed to be the same for all households. Applying the Monte Carlo method, data is generated 1 000 times, resulting in 1 000 different combinations of households where at least one member becomes unemployed after a shock scenario is applied. It is assumed that income of the unemployed person is replaced by the unemployment benefit, which, according to the methodology defined by the SIA[7], would have made up 43.7% of an average monthly wage in Lithuania as of Q2 2017.

[7] Unemployment benefit (in EUR per month) is defined by a formula: 114 + 0.3×W, where W is an average monthly gross salary of unemployed person in the last twelve months; the benefit cannot exceed 75% of an average monthly gross wage (that was 830 EUR as of Q2 2017).

3. Stress test of households with loans and its results

Scenarios employed in the stress test are foreseen by identifying which macroeconomic factors may systemically affect the whole financial system. Abrupt shocks in interest rates, unemployment, income and housing prices are considered the most pronounced sources of risk to the financial stability. In the stress testing model of the study these shocks occur immediately in the Q3 2017 and last for one quarter. It is presumed that the selected variables would develop according to their baseline scenarios afterwards until the end of 2018.

A shock is considered to be a highly unlikely event (significant change in earnings, interest rate, unemployment rate or housing prices) that would have a significant impact on the financial position of households. In order to obtain these characteristics, the shock's size is determined twofold: 1) as the standard deviation multiple of the relevant indicators time series (the standard shock scenario); 2) repeating the changes in interest and unemployment rates, and property prices in the period between 2008–2010, while the standard deviation of income time series is multiplied by 3[8] (an adverse shock scenario).

Baseline scenario is defined according to the Bank of Lithuania income and unemployment forecasts[9] and ECB interest rate forecasts[10]. However, neither these nor other institutions provide forecasts for housing prices, thus it is assumed that property prices would appreciate by 2% a year[11].

Standard shock estimates are calculated as:

$$RPS = BZN + fStd, \tag{3}$$

where *RPS* – estimated change of the variable in the next quarter, *BZN* – baseline scenario value, *f* – factor of 2 for interest, unemployment rate and earnings shocks, and factor of 1 for a property price shock, *Std* – standard deviation.

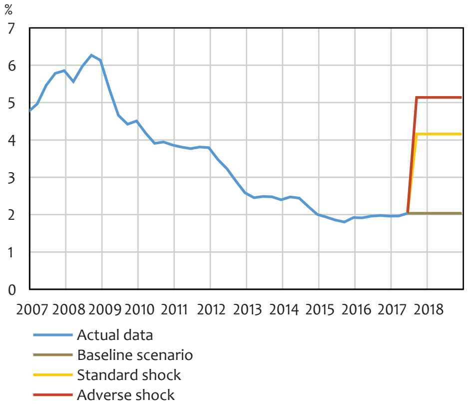
[8] The average net salary in Lithuania decreased by 7.1% during the recession of 2008–2009, less than by a standard deviation of 8.1%. As a result, a multiple of the standard deviation is chosen instead of imitating the repeat of conditions of previous crisis.

[9] As published on the Bank ol Lithuania website https://www.lb.lt/en/latest-economic-projections; forecasts interpolated to quarterly series.

[10] As published on the ECB website https://www.ecb.europa.eu/pub/projections/html/index.en.html; forecasts interpolated to quarterly series.

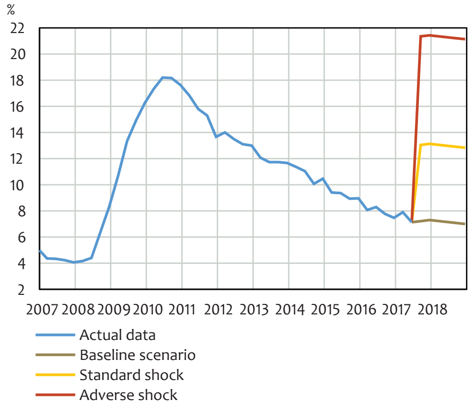
[11] According to this assumption, real value of residential property would not appreciate significantly in the long term as housing price growth would be similar to inflation rate targeted by the ECB.

Chart 2. Average interest rate dynamics of newly issued mortgage flow prior to and after the shocks



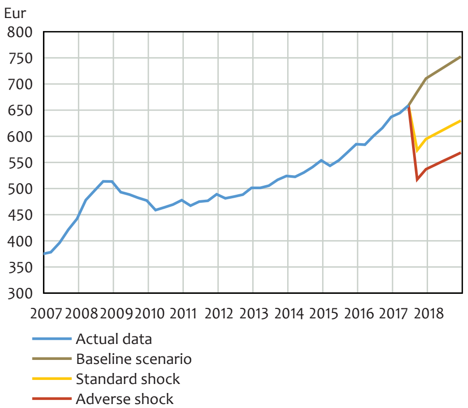
Source: own calculations based on Bank of Lithuania data.

Chart 3. Unemployment rate dynamics prior to and after the shocks



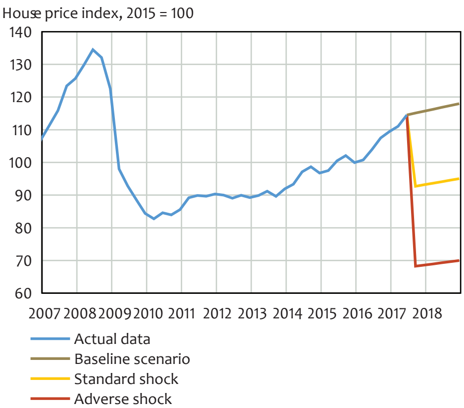
Source: own calculations based on Statistics Lithuania data.

Chart 4. Average net monthly wage dynamics prior to and after the shocks



Source: own calculations based on Statistics Lithuania data.

Chart 5. Housing price dynamics prior to and after the shocks



Source: own calculations based on Statistics Lithuania data.

Nevertheless, shocks in unemployment, interest rates, income and housing prices are most likely to materialize simultaneously as experienced during the economic crisis of 2008–2009 when income and housing prices fell, while at the same time unemployment and interest rates surged. Impact of such a joint shock is estimated for both standard and adverse shock scenarios allowing to explore the resilience of households and banks to severe economic conditions, and to compare the results with the same estimates of individual shocks.

Probability for the previously defined shocks to occur is estimated as a share of annual changes equal or exceeding the predefined size of each shock in total time series sample of every economic variable. The quarterly time series sample starts at Q1 1994, Q1 1998, Q1 2000 for interest rates and housing prices, unemployment level and wages, respectively. Shock sizes and their implied probabilities are provided in Table 1.

Table 1. Amplitudes and probabilities of stress test scenarios +

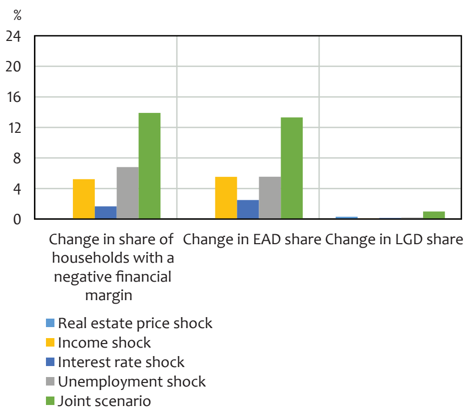
Stress test scenario	Standard shock	Adverse shock
Increase in unemployment rate	5.8 (6.8)	14.1 (1.5)
Increase in interest rate	2.1 (2.3)	3.1 (1.3)
Decrease in earnings	16.3 (–)	24.4 (–)
Decrease in housing prices	19.4 (5.6)	40.7 (1.4)

Source: compiled by authors.

Note: +all changes are measured in percentage points. A share of observations when economic shock is equal or greater than defined in a stress test scenario in the total sample of quarterly time series for every indicator is provided in brackets. If there were no shocks equaling those described in stress test scenarios in quarterly time series, probability is calculated by taking into account other periods than one quarter e.g., ten quarters in case of unemployment rate. Income in Lithuania has not experienced a larger drop than one standard deviation, but similar shocks were recorded in other countries e.g., in Greece over 2009–2015.

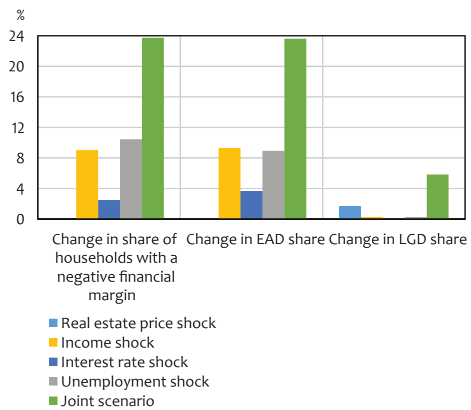
In the stress test, corresponding values in formulas (1) and (2) are replaced by the standard and adverse shock estimates, and these changes are applied to each household. Consequently, the effect of changes in households' financial position on a loan portfolio held by financial institutions is determined. Stress test results indicate that in case of individual standard shocks, credit institutions' exposure at default is the most increased by shrinking income and rising level of unemployment (see Chart 6). The stress test also suggested that households' financial margins were similarly affected by shocks in income and unemployment rate, and those two shocks both had a stronger effect than the loan interest rate shock. However, these results should be treated with a fair degree of precaution, because both the size of the shocks and their nature are different, as well as their transmission channels. Similarly to the results of standard individual shocks, in an event of adverse shock, the quality of bank loan portfolio would worsen the most due to lower income and an increase in unemployment rate, whereas surging loan interest rates would affect the quality of banks' mortgage portfolio to a lesser extent (see Chart 7). Such results would suggest that households are more sensitive to economic shocks severing their income e.g., massive job losses and shrinking wages. Consequently, such a conclusion would indicate that rising interest rates do not severe financial position of households as long as they have a source of income.

Chart 6. Impact of a standard shock to the bank performance indicators



Source: compiled by authors.

Chart 7. Impact of an adverse shock to the bank performance indicators



Source: compiled by authors.

Joint shock scenarios provide more realistic assessment of household resilience to economic downturns similar to the global recession of 2008–2009 as slowdown in economic activity usually triggers simultaneous shocks of income, unemployment and interest rates, housing prices. Results of the research indicate that if economic contraction mimics conditions set out in the standard shock scenario, credit institutions in Lithuania will lose 0.10 billion EUR. If the banks decided to cover these losses with their capital, it would have amounted to 3.9% of their total equity[12] as of Q2 2017. In case of a joint adverse shock scenario, losses incurred by the banks would be equal to 0.45 billion EUR, consisting 17.5% of their total equity.

Prior to application of the stress test scenarios, total debt of those households with mortgages, financial margin of which was negative, made up 8.6% of total credit accumulated by households with mortgages. Uncovered debt of these households

[12] Losses across different banks are distributed proportionally to their mortgage portfolios and only those banks are evaluated that had equity on their books e.g., the banks were not foreign bank branches.

consisted 0.39% of total loans extended to households with mortgages. Indicators depicting financial position of households with mortgages and their changes after the application of stress test scenarios are provided in Table 2.

Table 2. Household stress test results (in %)

Type of economic shock	Share of households with a negative financial margin	EAD to total loans	LGD to total loans
STANDARD SHOCK			
Share prior to the shock	8.6	12.5	0.39
Housing price shock	8.6	12.5	0.71
Unemployment shock	15.4	18.0	0.60
Income shock	13.8	18.0	0.54
Interest rate shock	10.3	15.0	0.46
Joint shock	22.5	25.8	1.39
ADVERSE SHOCK			
Share prior to the shock	8.6	12.5	0.39
Housing price shock	8.6	12.5	2.08
Unemployment shock	19.0	21.4	0.70
Income shock	17.7	21.8	0.66
Interest rate shock	11.1	16.2	0.50
Joint shock	32.4	36.1	6.22

Source: compiled by authors.

Stress test results reveal that in Q2 2017 banks in Lithuania were better prepared to face adverse macroeconomic conditions than before the crisis of 2008–2009. Throughout 2009–2010 banks that at the time operated in Lithuania suffered losses valued at 1.1 billion EUR in total on all loans and receivables, exceeding total equity (1.0 billion EUR) recorded on banks' books as of December 2008. However, economic situation, regulatory environment of the financial system and other important structural and cyclical components significantly differed at the time of the research from those in the pre-crisis period. For example, a similar drop to that of 2009 in residential real estate prices has been hardly expected as property prices in nominal terms are still by 14.8% below the peak of 2008, average salaries are by 28.3% higher than pre-crisis income peak and recent empirical studies concluded that housing prices in Lithuania are still undervalued[13]. Moreover, Bank of Lithuania introduced the Responsible lending regulations in 2011, and set

[13] ESRB Risk Dashboard, September 2017 https://www.esrb.europa.eu/pub/rd/html/index.en.html

maximum loan duration, loan-to-value and debt service to income requirements for households that have obtained mortgages since then. These macroprudential measures decrease a probability of unsustainable developments in household credit and housing markets.

Although banks that operated in Lithuania as of Q2 2017 were more resilient to various economic shocks than in the wake of 2008–2009 economic crisis, a simultaneous economic shock would have a noticeable impact on aggregate capital adequacy ratio of the banking sector that amounted to 19.9% in the middle of 2017. If banks had to cover losses incurred during a standard joint shock from their equity, this indicator would have decreased to 19.0%, and it would have further deteriorated to 16.0% in the aftermath of adverse joint shock.

Performance indicators of each bank operating in Lithuania were different in the time of research, thus sufficiently high average capital adequacy for the whole banking sector does not mean that all banks are equally resilient to potential losses. On the other hand, banks with the lowest capital adequacy levels as of Q2 2017, namely AB Šiaulių bankas (16.8%) and UAB Medicinos Bankas (15.7%), would not incur any significant losses after application of the stress test scenarios as their mortgage loan portfolios were relatively small, comprising 14.4% and 8.1% of their total loans to households, respectively. If losses on bank loan portfolios are distributed proportionally, capital adequacy ratio of these two banks will decrease by 0.19 and 0.12 percentage points in the aftermath of the adverse joint shock scenario, respectively. Thus, both banks with the lowest capital adequacy ratios would have comfortably met the minimum capital requirements (that were equal to 12.9% and 13.9% as of Q2 2017, respectively) under the scenario of simultaneous shocks in interest rates, housing prices, unemployment and income.

Estimates of the percentage changes rather than changes in absolute value terms should be considered when representing the results of this study. This is particularly relevant for variables related to household earnings as income data is not sufficiently reliable and estimates vary depending on the assumptions made prior to the stress test. However, these caveats are mostly offset by the large sample of HFMIS as all households that had a mortgage in the end of Q2 2017 are examined.

Conclusions

Simultaneous shocks in income, unemployment, interest rates and housing prices would be the most pronounced source of risk to the Lithuanian banking sector and consequently, financial system. Results of the study indicate that in case of standard and adverse joint shock scenarios losses incurred by banks from their mortgage portfolio would range from 1.3% to 17.5% of their total equity based on Q2 2017 data. Potential losses for branches of foreign banks that operated in Lithuania by the end of Q2 2017 and such a ratio are not estimated as they typically do not hold equity. Such losses, stemming from the households that have mortgages, would be significantly lower than aggregate losses sustained in the aftermath of the economic crisis of 2008–2009, suggesting that banks operating in Lithuania were more resilient to unfavorable economic shocks as of Q2 2017 than during the last recession.

Although origins and transmission channels of individual shocks in income, unemployment, interest rates and property prices are different, the size of every shock applied in this study is calculated on the basis of statistical time series, enabling to compare the effects of different shocks. The research unveils that banks will be affected the most if their borrowers are stretched financially due to an increase in unemployment rate or a decrease in income. Interest rate shock would cause lower damage to the financial soundness of banks in both standard and adverse scenarios. Falling property prices do not directly affect the financial position of households but noticeably increase losses incurred by banks as lower value of housing assets amplifies the negative effects of other economic shocks on the stability of the financial system in case of joint shock scenarios.

One of the major limitations of this research is a lack of good quality data. Micro-level data provided by HFMIS include all households that have taken loans from banks and other financial institutions, but household income data does not cover all possible sources of income. As a result, some assumptions about household earnings have to be made in the research, grounded by expert judgement. However, additional sources on household income would empower us to evaluate the financial position of households more accurately.

Stress test results would also improve after replacing the other assumptions with credible micro-level household data on loan agreement details (monthly loan balance and interest repayment, renegotiations like postponement of payments, etc.), total real property owned by household and financial assets like deposits and securities holdings. Thus, necessary amendments to the micro-level database used in this research (HFMIS) would allow more precise estimates of the impact that economic shocks may have on households with loans and the stability of the financial system.

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Chapter 15

Bubble on the Moroccan real estate market: Identification, cycles and macroeconomic conditions

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Introduction

For a long time, the theory of efficiency has provided relevant explanations with regard to the prices on the financial markets. Indeed, work of L. Bachelier (1900), Samuelson (1965) and Fama (1969, 1970) confirmed that prices often walk randomly and any prediction of their future trajectories is impossible.

These doctrines state that prices are influenced only by exogenous market factors of fundamental nature. The paradigm of efficiency stipulates that the prices at a given moment incorporate all economic and financial information (public and private) determining their future trends. From this point of view, the prices and the fundamental values coincide and any skid of the prices of their intrinsic securities is corrected by mechanisms of arbitration, speculation and hedging.

The close relationship between the prices and the fundamental value constitutes the basic postulate of the market efficiency theory. It would be very critical towards this relation of dependence (Co-integration) to call into question several fundamental aspects (rationality, transitivity and atomicity) of the market pricing of the capital.

However, the market evolution and the regular supervening of the financial and real crises throws market efficiency theory into question. The financial assets prices often deviate from their fundamental value. Keynes (1936) was the first to recognize that the market actors tend to behave irrationally instead of adopting a rational attitude (the example of mode competition).

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Capital markets witnessed several speculative bubbles, which brought prices to euphoric levels; however, most economic theoreticians continue to believe in the market efficiency and the fundamental value's objectivity. Although the prices are occasionally detached from their fundamental value, the markets tend to bring the prices back to their rational level.

In the same way, capital market actors, by putting more weight to the variables other than fundamental, contribute to the formation of a difference between the asset's financial price and its fundamental value, thus giving birth to a speculative bubble.

The theory of the speculative bubbles was developed in response to criticism formulated against the efficiency paradigm. Indeed, there can be a multiplicity of equilibriums on the capital market, not like a fundamental value hypothesis. Thus, the definition of the market prices should include an additional component to the fundamental value related to the anticipation of the future prices.

In theory, several forms of speculative bubbles exist of which most important include rational, intrinsic and irrational ones. The first family is known as rational, since it continues to adhere to the assumption of rational anticipation, according to which, the solution of the differential equation of the prices (Euler equation) admits a solution more general than that of the fundamental value (in the presence of the assumption of transitivity). The second family of bubbles is founded on the assumption that the price movements caused by euphoria result from the anticipation of future prices based on fundamental and exogenous market indicators. On the other hand, irrational bubbles are founded on the possibility of rejecting the rationality and the objectivity of the fundamental value.

Speculative bubbles following the example of financial markets frequently affect the real estate markets. Real estate is the subject of purchase and sale by agents driven by their future predictions. For this reason, the real estate price evaluation is a fundamental question which worries the market actors as well as public authorities because of the impact of this market on economic development and financial stability. The fall of the real estate prices has fatal consequences for the economy and in particular for the value of the balance-sheets of the various economic agents. Indeed, the real assets prices drop generates a fall of the financial assets prices, a deceleration of the economic growth and a loss of confidence resulting in a significant problems of the sectors connected to the real sector.

The international financial crisis showed the strong correlation between the real estate price levels and the economic growth prospects

Due to the importance of the real estate sector in Morocco, this study is interested in the analysis of the real estate price trend and verifying the assumption that there can be a speculative bubble on the real estate market in Morocco. For this reason, paper proposes several approaches to detect the speculative bubbles by using the real prices and rents indexes.

The rest of this paper is structured as follows: the next section presents a literature review on the speculative bubbles. Then, we present our empirical findings. The fourth and the fifth sections evaluate, according to two approaches, structural and non-structural, the presence of the speculative bubbles. Finally, the last section analyzes the cycle of speculative bubbles in order to detect the phases of explosion and deflation of the bubbles on the Moroccan real estate market.

1. Literature review

The theory of the speculative bubbles was often a subject of academic debates concerning the market pricing of capital and in particular the financial and real estate markets. A broad consensus was established on the fact that the prices often tend to deviate from their fundamental value, giving rise to speculative bubbles. The modern theory of finance rejects the existence of prices deviation from their fundamental value, by stating clearly that the financial markets are efficient and that the given price is an arbitrated price[3].

The efficiency theory was built on the assumption that prices are always efficient and their formation is purely exogenous stemming from changes in macroeconomic fundamentals. Thus, the difference between the price and the asset's fundamental value must be a white noise whose value is irrelevant. In practice, the majority of empirical work on the efficiency of the market is unable to validate with relevance the assumption of efficiency (strong, weak and semi strong).

Although the market efficiency paradigm remains to dominate modern finance, several authors investigated the formation of the speculative bubbles in order to describe the development of the asset prices. Famous stock exchange crashes also propelled this research orientation. Here are just few examples: tulip mania crash between 1631 and 1634 in Netherlands, Mississippi bubble[4] (1719-1720), the deflation of the prices during the crisis of 1929, the collapse of Internet bubble in 2001 and the subprime crisis in 2008.

[3] The arbitrated prices are those formed in a situation of lack of arbitration (see Fama (1963)).

[4] Bubble on the shares of the Company of the Mississippi and on those of South Sea Company (Company of the South Seas) in London.

These episodes of financial crises gave rise to several economic and financial theories capable of formulating answers concerning the causes of financial euphoria's birth. The most important contributions on the matter are those of Fisher (1932), Keynes (1936), Kindleberger (1978) and Minsky (1952). These authors suggest that formation of speculative bubbles is part of the business cycle and that massive debt supports the emergence of speculative bubbles. To the contrary, other authors assign formation of the bubbles to the intrinsic behaviors, and sometimes irrational, of the economic and financial agents and even with the nature of financial institutions (see Davis (1997).

The speculative bubbles were defined according to several disciplinary approaches. For the historian Kindleberger (1978), they are constant upward movements of the assets' prices, while the economists consider that the bubbles refer to the assets' prices which exceed the fundamental value since the investors always believe that they can resell their assets at higher prices (Brunnermeier (2009), Barlevy (2007), Diba and Grossman (1988a), West (1987)). On the same register, Garber (2000, p. 4) defines a speculative bubble as a part of the prices' curve which cannot be explained by the fundamental factors.

The bubbles thus come from an economic reality and an official report in relation to the indetermination of the solutions in the models of rational anticipation whose usual form, for the case of the assets prices is the equation of Euler. The indetermination of this solution is related to the existence of resale price which can accept several securities (solutions) and which also depends on the other future prices. Therefore, there exists an infinite number of solutions for the equation of Euler in the event of imposition of a condition of transversality, according to which the price at the infinite horizon tends towards 0.

The abolition of the condition of transversality makes it possible to include another solution of the Euler equation. Indeed, a possibility of assets resale implies that the price can deviate from its fundamental value, according to the following calculation:

$$P_t = \delta\left(E_t P_{t+1} + ED_{t+1}\right) \text{ "}Euler\ \ Equation\text{"} \qquad (1.1)$$

with: $\delta = 1/(1+x)$ and x is discount rate.

If we adopt the fundamental design of the evaluation of the assets prices with rational anticipations of Muth (1961), and by accepting the condition of transversality[5], then the fundamental value is regarded as being the single solution of the problem of valorization of the assets prices:

[5] This hypothesis indicate that the final price tend to became zero in long term.

$$P_t^* = \sum_{i=1}^{n} \delta^i ED_{t+i} \tag{1.2}$$

P_t^* is fundamental value.

In practice, the prices tend to deviate from their intrinsic value, suggesting the existence of a non-fundamental component. This deviation of the prices is often called speculative bubble. Based on the basic Euler equation, which determines the price of a financial credit, we can easily conclude that: the price of assets in date T depends on two components, which rise from two types of anticipations, namely: a component relating to the amount of the output and which is closely related to the fundamental and economic factors. This first component is exogenous compared to the market and is not influenced by the market. In addition, the second component is in relation to the prices of exit or resale on a date later i.e., relating to anticipations of the future prices by the various investors. It is indeed about an endogenous component at the market, B_t. Considering the above we obtain:

$$P_t = \sum_{i=1}^{n} \delta^i ED_{t+i} + B_t \tag{1.3}$$

On the basis of this analysis the fundamental value constitutes only one specific solution of the Euler equation, the second part of the solution results from the suppression of the assumption of transversality and makes it possible to converge towards a more general solution. This additional solution should lead to the emergence or the acceptance of a speculative bubble. However, in order for this solution to be in conformity with the assumption of rational anticipation and so that it is also accepted and allowed by all economic agents, it is necessary that this solution is rational and independent of the endogenous behaviors of the market. On the theoretical plan and so that the difference between the price and the fundamental value is rational (rational bubble), it is necessary that the equation (1.3) is a single and sufficient solution of the Euler equation (1.1).

We accept that:

$$E_t P_{t+1} = E_t \left[\delta E_{t+1} D_{t+2} + \delta^2 E_{t+2} D_{t+3} + \ldots + B_{t+1} \right] \tag{1.4}$$

If we use the iterative expectation law, we can obtain the following form:

$$E_t P_{t+1} = \delta E_t D_{t+2} + \delta^2 E_t D_{t+3} + \ldots + E_t B_{t+1} \tag{1.5}$$

After replacing $E_t P_{t+1}$ in the Euler equation we get:

$$\delta\left(E_t P_{t+1} + ED_{t+1}\right) = \delta ED_{t+1} + \delta^2 E_t D_{t+2} + \delta^3 E_t D_{t+3} + \ldots + \delta E_t B_{t+1} \quad (1.6)$$

Then:

$$P_t = \delta\left(E_t P_{t+1} + ED_{t+1}\right) = P_t^* + \delta E_t B_{t+1} \quad (1.7)$$

According to this calculation, it is clear that the solution with speculative bubble (rational) is a solution of the Euler equation and represents a more general solution in the absence of transversality condition. The deviation of the prices from their fundamental value is thus rational and always adheres to the assumptions of rational anticipation and objectivity of the economic model[6]. However, so that the solution with the component is single it is necessary that the equation above is in equivalence with the Euler formula (1.1). For this purpose, it is necessary that the bubble follows a martingale process, according to which the prediction of the future value of this martingale is its present value. On this register we impose the following definition of the rational bubble:

$$E_t B_{t+1} = \frac{B_t}{\delta} = (1+x) B_t \quad (1.8)$$

According to the above, the solution of the Euler equation is single and includes in addition to the basic components (dividends or rents), other components related to the future trajectories of the prices. From this point of view, the investors are not satisfied any more to only formulate anticipations on the future outputs, but also on the future prices, thus they contribute to increase the bubble in a rational way while being based on self-fulfilling prophecy[7] of future price. By adopting anticipations on the trajectory of the prices, the participants on the market continue to accept a fair game which supports informational efficiency. In other words, the prices include anticipations of the outputs and the future prices, therefore the probability of generating important gains is almost impossible.

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[6] Thus, one can define a speculative bubble as the difference between the real price of a financial credit and his fundamental value. According to Blanchard and Watson (1982), the existence of a resale price within the model of determination of the fundamental value is at the origin of the emergence of speculative bubbles. In other words, the possibility of negotiating and of renegotiating its assets on a resale market is at the origin of the speculative bubbles. However, if this assumption of renegotiation were to be eliminated, only the behavior qualified as "corporate" according to Keynes should exist.

[7] Anticipation of self-fulfilling is a form of rational anticipation which constitutes a form of answer as for the indetermination of the future of the economic world and which describes the beliefs of the individuals.

It should be also noted that the fact that $(1+x)$ is greater than 1 makes it possible to consider that the bubble is always ascending and consequently we draw aside the possibility of having negative speculative bubbles indicating the possibility of having negative prices $\lim_{n\to\infty} E(B_{t+n}) = +\infty$ and thus, it is noted that $B_t > 0$[8].

The first generation of rational bubbles models accepts their explosive character and does not integrate the possibility of their deflation (deterministic bubbles). However, Blanchard (1979) and Blanchard et al. (1982) develop this definition of rational bubble by admitting that the bubbles can burst according to a given probability. Indeed, he proposes to integrate a probability of crash landing into the level of the definition of the process martingale generator of the bubble, by adopting the following equation:

$$\begin{cases} B_{t+1} = B_t \left(\dfrac{1+x}{\pi} \right) & \textit{with probability } \pi \\ B_{t+1} = 0 \quad (1-\pi) & \end{cases} \tag{1.9}$$

Under the probability π the bubble continues its bullish tendency, while in reverse case the bubble is burst so that the assets price is equalized with its fundamental value. According to this definition the speculative bubble is characterized by a sustained high growth during the periods of rise of the prices, while in case of inversion of the prices the bubble becomes null. Thus, the bubbles can appear and disappear during the formation process of the prices. In this direction, the prices can only increase under the negotiable instrument of the bubbles, but in the event of their absence they are equalized with the fundamental value.

However, the nature of the bubbles on the capital markets is different from the model of Blanchard et al. (1982). Indeed, the bubbles can be periodic with several regimes whose value can't be zero. During a first phase, the bubble is constituted and grows until reaching a certain threshold, to enter second phase during which it increases, at faster intervals, where it deflates to be stabilized on an average level equal to discount rate x (see Evans (1991)).

[8] This condition is not however in the case of implemented bubbles defined within the framework of the model of hyperinflation of Cagan of 1956. Indeed, in this case, the variable prone to bubble represents the logarithm of the price level which can take negative securities without for as much the price level is negative.

2. Empirical studies

Several empirical approaches were developed of which most important will be thereafter detailed. The tests of the variance are the oldest tests regarding detection of the speculative bubbles. This approach was initiated by Shiller (1979, 1981) and is based on the fact that the financial assets price must be always in agreement with the fundamental value explained by the current value of the sum of the outputs. For this purpose, these tests were conceived to check the assumption of informational efficiency, however their use was enlarged to make it possible to detect the speculative bubbles. The principal idea of the method is to examine the relation which can exist between the development of the variance of the prices and the variance of the outputs of assets (approximation of the fundamental value). According to Shiller (1981) the generated error of the difference between the price and the fundamental value must be not correlated with the fundamental value and must be also equal to 0. In this direction, the volatility of the prices must entirely result from the volatility of the value intrinsic to the economy, or lower. A volatility of the prices more important than that of the fundamental value can induce the existence of factors other than those fundamental intervening in the market pricing.

On the empirical level, knowing the difficulty of defining the fundamental price, Shiller (1981) considered that the price trend is an approximation of the fundamental value and that discount rate is constant. The results obtained by the author on the series of SP500 data from 1871 to 1979 confirm that the prices are equipped with volatility largely higher than that of the dividends, then one can confirm the existence of speculative bubbles. LeRoy and Porter (1981) developed a similar approach by using the profitability of the assets and they managed to corroborate the results already forwarded by Shiller (1981).

The approach of West (1987) is different from that of Shiller (1981), in the direction where it is based on the checking of two assumptions; H0: according to which the courses of action are fixed by a model adhering to the assumption of efficiency of the markets, while H1 indicates that the prices, in addition to the basic component, are composed of a speculative bubble. Author thus compares two models. The test thus suggested three stages: the first consists in estimating the fundamental value by using the hoped securities of the returns on assets (dividends) by using an estimate of instrumental variables. In the second place, the author uses an estimate ARIMA to describe the generating process of the dividends (or rents). Lastly, the last model describes the relation between the real prices and the outputs. The results of three stages are compared in a test of the obtained coefficients.

The results obtained on market indexes SP 500 (1871–1980) and the index Dow-Jones (1928-1978) made it possible to reject the null assumption of absence of bubble. Demirguc-Kunt (1990) uses the same step recommended by West (1987) on very small samples and manage to conclude that it is difficult to affirm the conclusion of West (existence of bubbles) on similar samples.

For Diba and Grossman (1988a, 1988b) detection of speculative bubbles, is is based on the stochastic properties of asset prices. It is indeed a question of examining the assumption of co-integration of the two series. Thus, if the series of the dividends are not stationary, the price on the market must be also integrated in the same order, under the assumption of speculative inexistence of bubbles. In practice, two authors used the test of Bhargava and the method of Engel-Granger to affirm or deny the existence of speculative bubbles[9].

Evans (1991) stresses that bubbles are supposed to appear and disappear throughout the formation process of the prices within the capital markets. He rejects the relevance of the tests of roots unit and also of co-integration in detection of the periodic speculative nature of bubbles. The simulations used by the author confirm that when the bubbles appear on the markets, the stock exchange do not seem to be more explosive than the dividends within the meaning of the unit tests of roots, which allows one to predict a weakness of these tests and leaves the problem of bubbles detection.

Froot et al. (1991) provide a fundamental distinction between the rational bubbles and the intrinsic bubbles. The first result from the developments of exogenous macroeconomic factors, while the intrinsic bubbles have endogenous sources (factor related to the firms). Their model is based on a nonlinear relation between the fundamental value and the assets prices. This nonlinearity is the reason according to which a change in fundamental factors has an impact on the assets price, giving rise to speculative bubbles.

Donaldson and Kamstra (1996) built a non-linear model ARMA-ARCH-ANN[10] to provide for growth rates of the dividends thus allowing to obtain an approximation of the fundamental value. By approaching the fundamental value simulated with the real prices they could not reject the assumption of existence of bubble.

[9] These approaches based on the implementation of the unit tests of roots and co-integration were largely criticized by authors (Charemza and Deadman (1995) and Evans (1991)) because of their incapacity to collect deflations of bubbles. Indeed, in the event of existence of periodic or seasonal bubbles, the unit tests of roots can reject their existence in favor of a perfect co-integration between the intrinsic prices and variables.

[10] Artificial Neural Network *ARCH.*

Koustas and Serletis (2005) used a fractional modeling using the average autoregression models mobile fractional integrated (ARFIMA) to test the presence of bubbles. The results obtained using the traditional procedure of the tests of roots unit and that of fractional integration made it possible to reject the assumption of absence of bubbles on the studied markets.

Wu (1995 and 1997) presents a more innovative way of detecting speculative bubbles. He suggests that the rational bubbles deviate from fundamental value. On the basis of formula of Campbell and Al (1988), the author proposes to express the variation of the real prices according to the sum of two components, namely: variation of the dividends and variation of the rational bubbles. By taking account of the fact that the bubbles are unobservable components of the price, the author proposes the use Kalman filters in order to quantify their development.

Van Norden (1996) and Van Norden and Vigfusson (1998) proposed to use the tests of regime change in Markov (Markov switching model) in order to detect the phases of explosion and of deflation of the speculative bubbles according to the definition suggested by Kindelberger (1978). Indeed, they define two probable states. First, relative to a significant rise of the prices and the second indicates a deflation of the bubble and a return to the fundamental value.

Nael Al-Anaswah and Bernd Wilfling (2010) use a model of space state with chain of Markov to test the presence of bubbles. For this purpose, they use a model describing the current value of the financial assets which is estimated via the filter of Kalman. Thereafter, authors use the chain of Markov in order to detect the regimes (bull and bear) controlling the development of the speculative bubbles.

Philips, Shi and Yiu, (2011) propose a generalization of the test ADF (sup ADF) which makes it possible to detect the bubbles on the capital markets. The implementation on SP500 index shows clearly that between 1871 and 2010, several bubbles were identified. Matthew S. Yiu and Al (2012) forward an implementation of the method suggested by Philips, Shi and Yiu (2011) on the real estate market in Hong Kong. Their results confirm the presence of several positive bubbles on this market of which the most important is that of 1997.

The examination of work on the speculative bubbles lets one to predict several approaches of detection of the speculative bubbles. The approach suggested in this paper rests on two methods of identification of the bubbles on the Moroccan real estate market. The first method is based on direct tests and univariate in order to collect the statistical properties of the price series and to decide on the presence of bubbles. This approach uses tests of roots, stationarity and co-integration. The second method suggested bases on the structural use of a model (Campbell and

Al (1988)) defining the prices in two large components: a fundamental part and another relative to a bubble.

Taking as a starting point the work by Bong and Al (2010), we approximate the real assets price through the price index of the real assets (IPAI). Incomes generated by the detention of the real assets are the rents paid by tenants and consequently the rents are regarded as being the fundamental factors. In the absence of statistics describing the yield, we use average rents based on the rent index which is the component of consumer price index (IPC). For this purpose, tests and the models which will be used to check the presence of bubbles on the Moroccan real estate market will be carried out by using these two indicators.

3. Statistical approach's

Statistical tests were the first to be used to deny or confirm the existence of speculative bubble on the capital markets. These tests base on a fundamental idea, according to which, two processes influencing prices and the dividends must be co-integrated, in the event of absence of speculative bubble. Diba and Grossman (1988) were the first to implement this type of approach by suggesting the use of the tests of unit roots and the co-integration tests, in particular ADF test, the test of Granger and Engel and the test of Bhargava. Other recent approaches adopt new tests of unit roots without the limits of the traditional tests. Indeed, they assume existence of deterministic bubbles answering the definition of Blanchard and Al (1979, 1982), without having to claim that the bubbles can be characterized by several regimes. Thus, other statistics, taking account the criticism of Evans (1991), were used, in particular of those of Bussetti-Taylor (2004), of Philips and Al (2011, 2012).

3.1. First generation test

Diba and Grossman (1988) proposed to identify the speculative bubbles by using three statistical tests – ADF, co-integration test and the test of Bhargava. In theory, they used the definition of the rational bubbles to describe the unobservable part of the assets prices, which is the difference between the real price and the fundamental value. In this direction, the linear combination, described according to the definition of the rational bubbles, between the prices and the fundamental value (dividends or rent) makes it possible to identify the presence of bubble. In other words, if the prices and the dividends (or rents) are co-integrated.

The test procedure is based on a use of several statistics making it possible to validate the null assumption of non-existence of bubble by indicating that the assets prices and the outputs are integrated, in this respect the assumption of nonexistence of bubble is checked.

The first test used is that based on the statistics of the test of augmented Dickey Fuller (ADF) which makes it possible to check for the existence of unit root in the series in question.

Table 1. Test ADF on the series of the prices and the outputs

Series	ADF probability	Lag used in ADF
Log of outputs (LD)	0.0006	9
Log of the real assets prices (LP)	*0.9507*	9
D(LD)	0.0006	9
D(LP)	0.0000	9

Source: own calculations.

It arises according to the analysis of the statistics ADF which the prices and the outputs are stationary order 1, while, the series in level has an unit root. Indeed, the series of the prices are no stationary in level, on the other hand, the series of the outputs (rent) are stationary. These results prove that for a first test prices seem to be not co-integrated with the series of the outputs. For this purpose, the variations of the real assets prices are not similar to a volatility of the fundamental value.

Diba and Al (1988) also propose to use the method of Bhargava and al. (1986) to test the nature of the relation between the assets prices and the outputs which result from this. Indeed, if the prices are completely explained by the fundamental value, from this point of view, the residues of the linear relation between the prices and the rents should be stationary. Test of Bhargava makes it possible to check this assumption directly.

Table 2. Bhargava test

Series	Bhargava stat	Observation number
LP-LD	–1.56	51

Source: own calculations.

According to the statistical table of Lee and Schmidt (1994) and knowing that the number of observations is between 50 and 100, then –1.56 is much higher than the critical value at 1%,–18.3 and –19.3. In this respect one can conclude that the linear combination between the real assets prices and the price of the rent is no stationary at level but in first difference.

To confirm the obtained results, we used a third test, suggested by the authors, of co-integration between the two variables. The tests of Johansen and Granger-Engel were used to check the existence of this relation.

Table 3. Johansen test

Assumption	Eigenvalues	Statistical test	Critical Value to 5%	Critical probability
None	0.20	13.65	15.49	0.09
At most 1	0.05	2.78	3.84	0.09
The test of the trace indicates that the series are not co-integrates with the threshold of 5%				

Source: own calculations.

Table 4. Granger test

	Z-statistic	Critical probability
Log real prices	−7.147741	0.5323
Log rent	−6.648238	0.5748

Source: own calculations.

According to the two tests of co-integration, two series of the prices and the outputs are not co-integrated with the threshold of 5%, so it is difficult to reject the assumption of existence of bubble. Long-term independence of the real assets prices compared to the index of the rent confirms that other components contribute to the explanation of the trend of prices on the Moroccan real estate market. According to these results, one can note that the residue of the linear combination between the two aggregates, real assets prices and the index of the rent, are not stationary what allows to predict the existence of a persistent gap on the level of the price index of the real assets which cannot be explained on the basis of the fundamental value.

The approaches suggested by Diba and Grossman (1988) rest on tests of unit roots on the series of the assets prices and the series of the dividends (rents) to check the correspondence between the two variables and to check for the existence of speculative bubble. This methodology rests indeed on the adoption of a step of co-integration. However, the criticism of Evans (1991) called in question this approach based on the tests of unit roots (in particular co-integration tests). It proved that these tests do not make it possible to find cases where the bubbles are formed and deflated. Consecutive collapses of the bubbles complicate the possibility of detecting in an effective way the existence of bubbles on the various capital markets.

3.2. Second generation tests

The tests of unit roots and the tests of co-integration do not provide a convincing analysis of the existence of speculative bubbles on the capital markets. Indeed, these tests can be skewed. Indeed, it is necessary to note that the series is characterized by a regime change according to which, it can vary between a stationary state is an explosive state. The speculative bubbles appear and disappear according to an unknown frequency, which shows a quasi-cyclic character.

In answer to the criticism of Evans (1991), other tests were developed in order to better diagnose the presence of speculative bubbles. Among these approaches are those proposed by Bussetti et al. (2004) and Philips, Wu, Yu (2009, 2011, 2012). "PWY" seems to be more relevant.

Bussetti and Taylor (BT, 2004) propose statistics to test the assumption according to which a series is stationary compared to an alternative assumption which suggests that the series passes from a stationary regime to a regime I (1). The test is based on the calculation of the following statistics:

$$supBT\left(\tau_0\right)= sup_{\tau\epsilon\left[0,1-\tau_0\right]}BT_\tau \tag{1.10}$$

where:

$$BT_\tau = \frac{1}{s_0^2\left(T-\tau T\right)^2}\sum_{t=\left[\tau T\right]+1}^{T}\left(y_T - y_{t-1}\right)^2 \tag{1.11}$$

s_0^2 is an estimate of the variance. τ is under interval.

The use of BT test (2004) provided results more or less similar to those obtained using the statistical tests previously used. Thus, one can reject with the critical value of 5% the assumption of stationarity of the series of the real estate price index to the detriment of the alternative assumption, according to which, the real assets prices is not stationary but in presence of bubble behavior.

PWY (2009, 2011, 2012) use a sup ADF (SADF) according to which usual test ADF is performed on small fragments of the series in a sequential way, on several occasions, by prolonging each time the samples used (windows). Then, a statistical test of inference is created to check for the existence of explosive behavior suggesting the presence of bubble. They manage to confirm the usability of their test, compared to other traditional tests like unit roots and co-integration[11], in finding speculative bubbles.

Table 5. BT test (2004)

Log of price index of the real assets	1.4858
Critical value	
90%	0.5057
95%	1.0153
99%	5.9401

The breaking values were obtained using simulation (5,000 iterations) on a sample of 51 observations and with an interval $\tau 0=0.1$.

Source: own calculations.

Moreover, PWY (2012) propose an improvement of their test to detect several speculative bubbles by generalizing procedure SADF. Their new test provides a more suitable framework of analysis of the explosive behavior of the long series and gives a more relevant valuation of the speculative bubbles which can emerge over more or less long period.

The new test suggested by PWY (2012) is called GSADF (generalization of sup ADF). Based on the same principle as SADF, the GSADF is more flexible in finding initial points windows to be tested. Thus, these two tests make it possible to diagnose any explosive behavior in the series of the prices and to ensure a higher number of observations.

Statistical test SADF is based on a sequence of test ADF usually used to detect the existence of unit roots. Sample of regression (ADF) starts from a moment $\tau 1$ and finishes at final moment $\tau 2$, with $\tau 2=\tau 1+\tau \mathrm{w}$ and $\tau \mathrm{w}$ is the fraction of the sample used at the time of the regression. In this case the number of observations used in the regression equals $\mathrm{Tw}=\mathrm{T}^{*}\tau \mathrm{w}$. The test is thus based on a repetition of test ADF on several temporal breaches $\tau \mathrm{w}$ which start at $\tau 1$ and arrive $\tau 2$. Thus, $\tau \mathrm{w}$ enters $\tau 0$ and 1 and $\tau 0$ is given in such a way that the estimate of test ADF is effective. These new ADF statistics are commonly called SADF and calculated as follows:

$$SADF = sup_{\tau \mathrm{w} \in [\tau 0\ ,1]} ADF_{\tau \mathrm{w}} \tag{1.12}$$

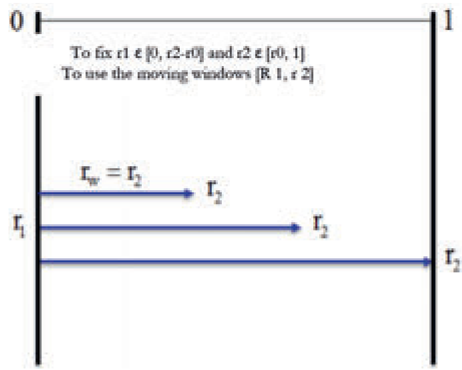
[11] Homm and Breitung (2011) also affirm, using simulations Monte Carlo, the supremacy of the test of PWY (2011).

Which can be written in an asymptotic form:

$$SADF = sup_{\tau w \in [\tau 0\ ,1]} \left\{ \frac{\tau w \left[\int_0^{\tau w} WdW - 1/2\tau w \right] - \int_0^{\tau w} WdW(\tau w)}{\tau w^{1/2} \left[\int_0^{\tau w} W^2 dr - \left[\int W(\tau) d\tau \right]^2 \right]^{1/2}} \right\} \qquad (1.13)$$

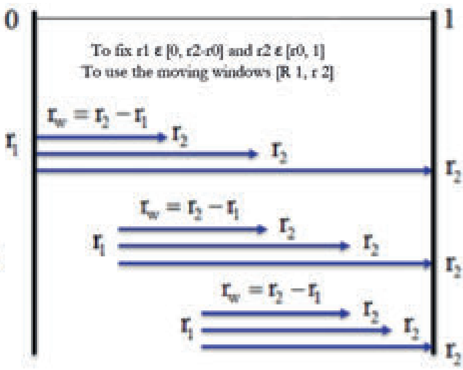
Under the assumption that W is a stationary process.

Figure 1. SADF test



Source: own calculations.

Figure 2. GSADF test



Source: own calculations.

Test GSADF is based on a reproduction of ADF test on a sequence of small samples even broader than that deployed in SADF test. Indeed, the fact of changing the starting point of the test " $\tau 1$ " provided several windows on which one can carry out ADF test. From this point of view the GSADF is defined in the following form:

$$GSADF(r0) = \sup_{\substack{r2 \epsilon [r0,1] \\ r1 \epsilon [0, r2 - r0]}} \{ADF\} \qquad (1.14)$$

Another fundamental contribution of the authors is to arrive to set up of the tests of detection of the bubbles dates' formation, by using recursive tests with SADF statistics. More precisely, the strategy consists in comparing statistics resulting from one canvassed recursive of statistics SADF and GSADF (BSADF, BGSADF) with the breaking values of SADF, which makes it possible to detect the dates of formation of the bubbles or the start dates of the explosion of the variable.

Tests SADF and GSADF can also detect the existence of the speculative bubbles on the level of the series of the prices through the replication on several under sample of the series of ADF test in answer to the criticism formulated by Evans (1991). Authors PWY (2011, 2012) set up statistical tables which describe the breaking values of the two tests.

By implementing the two tests to the series of the prices and the rents, the results obtained are as follows:

Table 6. Tests

	SADF Test	GSADF Test
Log of real assets prices	0.7058	2.6392
Log of index of the rents	–1.2689	0.1204
Critical value		
90%	2.7879782	1.1915780
95%	3.4615806	1.5360598
99%	3.5906605	2.1555409
The tests were carried out on a sample of 51 observations and with an interval r0=0.4, the breaking values were obtained on the basis of 5000 Monte Carlo simulation.		

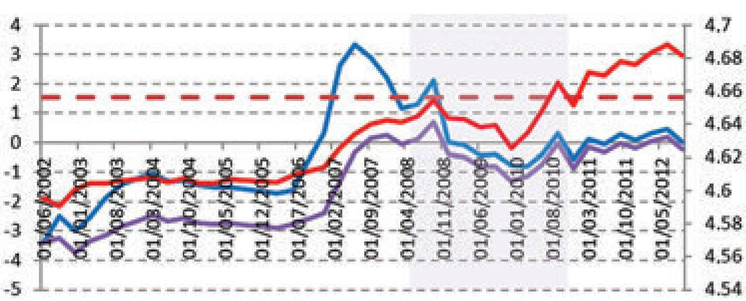
Source: own calculations.

The analysis of the results obtained affirms that the series of the real assets prices is explosive. Indeed, test GSADF is higher than the breaking values with the threshold of 1%, 5% and 10%, which implies that the series can be characterized by the existence of a speculative bubble.

In addition, with regard to the series of rent index, the H0 assumption cannot be rejected and consequently the series indicates the presence of an explosive behavior making it possible to explain the explosion of the series of the real prices.

Using recursive test BGSADF developed by PWY (2012), we can provide an estimate of the date of formation of this bubble in Morocco. This is presented in the following graph:

Figure 3. Identification of the boost period of the real estate prices index



Source: own calculation.

According to the development of recursive test BGSADF we note that the value of the test largely exceeds the breaking value of test GSADF (1.53). Thus, there was a bubble during the period from December 2006 to March 2009.

These results can be confirmed using the tests of change regime which make it possible to detect the points of change of the tendencies of the time series. For that purpose, we use the Zivot-Andrews test and the statistics of the Chow type implemented to ADF test (sup DFC). The results confirm the results of tests SADF and GSADF.

Table 7. Tests

	Zivot Andrews	Test of sup DCF
Log of real assets prices	−4.64 (0.06)	2.3486 (0.00)
Critical value		
90%	−5.57	1.5762
95%	−5.08	1.9327
99%	−4.82	2.2685

Source: own calculations.

By comparing the two tests with their breaking values, the assumption of absence of speculative bubbles is difficult to reject. In this direction, we can confirm that there was a deviation of the prices compared to their fundamental value. The last two tests also confirm that the explosion of the series of the assets prices which has started since 2006, corroborated the results of the preceding tests.

The use of the statistical tests of the first and the second generation affirms that the series of the real estate's price index is explosive and seems to be independent, not co-integrate, of the developments of the rents. This confirms that the trend of prices indicates the presence of a speculative bubble.

4. Structural approach

The concept of speculative bubble is strictly related to the developments of the assets prices on the various financial markets. The assets prices are often higher than the fundamental value suggesting another source of price changes. Keynes (1933) mentioned this in his famous example about the contest of mode. In fact, the actors on the markets are not interested solely in the economic factors in order to provide for the trajectories of the prices, but they also stick to anticipations of other actors as for the future trend of the assets prices.

The examination of the statistical properties of the series of the real assets prices and the series of the rents confirmed the presence of an explosive nature in the first series thus representing the formation of a speculative bubble in the period 2006–2008. However, the statistical tests are limited only to the econometric properties of the analyzed series, without taking account of an economic design and a definition more structural of the speculative bubbles. For this purpose, other economic approaches (structural) were suggested in order to check the assumption of existence of bubble on the capital market.

4.1. West model

The central idea of West (1987) model is to test the assumption according to which the price reflects fundamental value, against the assumption that the price, in addition to the fundamental value, includes another component, which is the speculative bubble.

Let us note that:

$$S_t = P_t^f + B_t \ \ où \ S_t = P_t^f \tag{1.15}$$

In the case of the West model, we note that the bubble B_t is defined according to the model of Blanchard and Watson (1982) and that the discount factor is unknown and should be estimated. It also supposes that the dividends follow an auto-regression process (AR (P=1)).

$$D_t = \theta D_{t-1} + \varepsilon_t \quad avec: |\theta| < 0 \tag{1.16}$$

It is also known according to rational anticipation that, $\sum_{i=1}^{\infty} b^i D_{t+i} = \gamma D_t$, then we can write that $\gamma = b\theta / (1 - b\theta)$. If the assets price is equal to the fundamental value, then:

$$S_t = P_t^f = \gamma D_t \tag{1.17}$$

According to this design, the West model proposes to estimate three equations (5, 6 and 1). Equations 1.16 and 1.17 can be estimated with ordinary least square method (OLS), while, the first equation has a forward looking character, which requires the adoption of an estimate with instrumental variables or by using the generalized method of moments (GMM).

In order to check the existence of bubble in the series of the assets prices it is necessary to compare two estimates, direct and indirect, of γ. Divergence of the two estimators, confirms that there exist other factors that explain the trend of prices.

The series used are relating to the price index of the assets and the index of the rents. The latter is an approximation of the real returns on assets. West model initially estimates the process of the dividends using ARIMA model. For this purpose, the Stepwise approach was used to obtain the optimal delays. We obtained the following model:

$$\log(D_t) = 0.96^{(0.00)} log(D_{t-1}) + 0.14^{(0.00)} \tag{1.18}$$

For the two other equations the estimate was carried out using the instrumental variables and the results obtained are presented in the following table:

Table 8. Estimation of 1.16 and 1.17 equations

	Coefficients	t-Statistic	Critical probability
b	0.501667	2942.179	0.0000
γ	1.007637	1638.173	0.0000

Source: own calculations.

According to the estimates, the discount factor is equal to 0.5, which is the rate required by the holders of the real assets is approximatively 50%. In other words, the purchasers of the real assets expect a yield equal to 50% for each real assets, which is a more or less important rate. Concerning the factor γ, it was estimated using the instrumental variables and the value obtained equals 1.0007.

According to the specification of West (1987), we can determine γ according to the following relation: $\gamma = b\theta / (1 - b\theta)$. The use of a test of Wald to compare the two estimates of γ allows to obtain the following results:

Table 9. Wald test $\hat{\gamma} = \dfrac{\hat{\mathbf{b}}\hat{\theta}}{1 - \hat{\mathbf{b}}\hat{\theta}} = \gamma$

Statistical test	Value	Probability
Chi-square	23.98319	0.0000

Source: own calculations.

On the basis of result of the test of Wald, the coefficient γ seems to be different for the two types of estimate. So we can affirm that the fundamentals are not the only determinants of assets prices. It is why we can state that there exists a speculative bubble in the real assets prices formation process. Although the West model (1987) makes it possible to validate in a structural way the existence of a speculative bubble, it is unable to quantify the development of it new approach based on Kalman Filter.

4.2. Kalman filter approach

A new approach presented by several authors is based on the use of the Kalman filter. Indeed, since the bubbles are unobservable components in the assets prices, Wu (1995) set up a methodology to extract the bubble from the series of the assets prices.

On the basis of work of Campbell and Shiller (1988), who could develop the Euler equation under the assumption of constancy of the yields and using a Taylor development, a new linear representation of the prices can be considered:

$$P_t = c + \alpha P_{t+1} + (1-\alpha) D_{t+1} - x_{t+1} \tag{1.19}$$

The analysis of this relevant relation emphasizes that the price of a financial credit is according to the outputs which it can get following its detention and also on an anticipated price level. Thus, the model of Campbell et al. (1988) makes it possible to obtain a general solution for the equilibrium prices of assets.

By retaining that the fundamental value of the financial assets is equal to:

$$P_t^f = \frac{(c-x)}{(1-\alpha)} + (1-\alpha)\sum_{i=0}^{n} \alpha^i E(D_{t+i}) \qquad (1.20) \tag{1.20}$$

with:

$$c = -\ln(\ \alpha) - (1-\alpha)\left(\ln\left(\frac{1}{1+D/P}\right)\right) \text{ and } \alpha = \frac{1}{1+D/P}$$

On the basis of the definition by Campbell et al. (1988), the fundamental value is define by:

$$\Delta P_t = \Delta P_t^f + \Delta B_t \tag{1.21}$$

ΔP_t^f is the variation of the fundamental value and ΔB_t is the variation of the speculative bubble.

In this case, the fluctuations in prices are described according to the following calculation:

$$\Delta P_t = (1-\alpha)\sum_{i=0}^{n}\alpha^i E\left(D_{t+i} - D_{t+i-1}\right) + \Delta B_t \tag{1.22}$$

According to Wu (1995 and 1997) the first part of the above equation can be in relation to the developments of the hopes of output of the dividends and is approximated according to a process ARIMA (H, 1, 0) with drift. The author thus proposes to forward the variation of the dividends according to the following form:

$$\Delta d_t = u_t + \sum_{i=0}^{n}\delta_i \Delta d_{t-i} + \varepsilon_t \tag{1.23}$$

with, $\varepsilon \rightarrow N\left(0,\sigma^2\right)$ and u_t is a drift.

The resolution of the basic Euler equation is conditioned by the determination of the conditionally anticipated outputs, which is not also obvious. This problem known under the connotation "multiplicity equilibrium" was mentioned by a big number of theorists. The existence of variables anticipated in the fundamental equilibrium equation complicates the possibility of estimating a value of balance of it, since there exists a possible infinity of solutions[12]. In order to circumvent this constraint, Wu (1995) proposes approach based on the methodology of Campbell (1988) by achievements that:

$$Y = AY_{t-1} + \eta \tag{1.24}$$

where:

$$y = \begin{pmatrix} \Delta \mathrm{d}_t \\ \Delta \mathrm{d}_{t-1} \\ . \\ . \\ \Delta \mathrm{d}_{t-n} \end{pmatrix}, \ \eta = \begin{pmatrix} \varepsilon \\ 0 \\ . \\ . \\ 0 \end{pmatrix} \ \text{et} \ A = \begin{bmatrix} \delta_1 & \cdots & \delta_n \\ \vdots & \ddots & \vdots \\ 0 & \cdots & 0 \end{bmatrix}$$

If it is considered that $g = (1,0,0,\ldots,0)$, we can thus write that:

$$\Delta d_t = gY_t \tag{1.25}$$

12 See Blanchard [1979a], p. 115 and Gourieroux and Al [1982] and Mac Callum [1983].

In this direction, we can rewrite the value of the expected dividends in the following form: [13]:

$$E_t\left(\Delta D_{t+i}\right) = gE_t Y_{t+i} = gA^i Y_t \tag{1.26}$$

If it is noted that $E_t\left(D_{t+i}\right) = E\left(D_t + \sum_{j=1}^{i} D_{t+j}\right)$, then:

$$E_t\left(D_{t+i}\right) = D_t + g\sum_{j=1}^{i} A^j Y_t \tag{1.27}$$

By replacing the equation by the value of price variation:

$$\Delta P_t = (1-\alpha)\sum_{i=0}^{n}\alpha^i\left[D_t + g\sum_{j=1}^{i} A^j Y_t - D_{t-1} - \sum_{j=1}^{i} gA^j Y_{t-1}\right] + \Delta B_t \tag{1.28}$$

In this direction we can finally write that:

$$\Delta P_t = \Delta D_t + \Delta Y_t + \Delta B_t \tag{1.29}$$

This relation thus makes it possible to collect the variations of the prices explained by the means of the variations of the dividends and the variations of the bubbles. Wu (1995 and 1997) proposes to model the variations of the prices with the use of the Kalman filter. The choice of this approach is based on impossibility to quantify the component B_t since it remains unobservable while belonging to the curve of the prices.

The Kalman filter is a filter which makes it possible to estimate components unobservable using other measurable variable by this formulation:

$$\begin{cases} y = c(1) + c(2)x + \varepsilon \\ x_{t+1} = c(3) + c(4)x + \vartheta \end{cases} \tag{1.30}$$

where C (.) are the parameters to be estimated, $\varepsilon(0,v1)$ and $\vartheta(0,v2)$ are the errors of the models. The first equation of the system is the equation of measure, while, second is often qualified equation of state or transition. The simulation of the unobservable variable passes through three fundamental stages.

The first stage consists in providing for the value of X at the moment (T-1) and its variance σ_x^2 while basing itself on the following:

[13] With $Y_{t+i} = A^i Y_t$ as a form of capitalization.

$$\begin{cases} x_{t|t-1} = c(3) + c(4)x_{t-1} \\ \sigma^2_{t|t-1} = c(7) + c(4)^2 \sigma^2_{t|t-1} \end{cases} \tag{1.31}$$

In the second stage and at the moment "T" we have information on the variable observed "there", then we can provide an estimate of ε :

$$\varepsilon = y - c(1) - c(2)x_{t|t-1} \tag{1.32}$$

The variance of the error is written in the form:

$$v1 = c(2)^2 * \sigma^2_{t|t-1} \tag{1.33}$$

To estimate the securities of X and its variance we thus have to recourse to the securities of ε and of $v1$. For this purpose, we can write that:

$$x_t = x_{t|t-1} + \frac{c(2) * \sigma^2_{t|t-1} * \varepsilon}{v1} \tag{1.34}$$

$$\sigma^2_t = \sigma^2_{t|t-1} + \frac{c(2)^2 * \sigma^2_{t|t-1}}{v1} \tag{1.35}$$

For estimation, we can minimize the conditional variance.

In the last stage, we use the method of maximum likelihood in order to estimate the parameters C (.). The function of probability is:

$$L = \frac{1}{2}\sum_t \log(v1) - \frac{1}{2}\sum_t \frac{\varepsilon}{v1} \tag{1.36}$$

The use of the Kalman filter should allow to extract the component bubble,, of the series of the real assets prices, by taking account of the developments of the fundamental value. From this point of view, we consider the equation proposed by Wu (1995):

$$\Delta P_t = \Delta D_t + \Delta Y_t + \Delta B_t \tag{1.37}$$

where:

ΔP_t: is the variation of the price index of the real assets;

ΔD_t: is the variation of the index of the rents (approximation of the real returns on assets);

ΔB_t: is the variation of the speculative bubble.

In order to apply this approach, it is necessary to identify two equations of measure and two equations of transition or state:

The equations of measure, integrating the observable variables P and D, are:

$$\Delta P_t = \Delta D_t + \Delta Y_t + \Delta B_t \tag{1.38}$$

$$\Delta d_t = u_t + \sum_{i=0}^{n} \delta_i \Delta d_{t-i} + \varepsilon_t \tag{1.39}$$

The equations of transition are:

$$Y = AY_{t-1} + \eta \tag{1.40}$$

$$\Delta B_t = \gamma \Delta B_{t-1} + \mu \tag{1.41}$$

The estimates using the maximum of probability are carried out quarterly from 2000 to 2012. The variation of the price index of the assets can be negative what allows to predict the possibility of having negative variations in the component bubble (see Cagan (1956)).

The estimate of the equation of Wu (1995) by Kalman filter provided the following results:

Table 10. Kalman filter estimation

Coefficients	Value
C(1)	0.136075 (0.00)
C(2)	0.430003 (0.00)
C(3)	0.699998 (0.00)
State variables	
ΔD_t	0.164742 (0.00)
ΔY_t	0.066667 (0.00)
ΔB_t	−0.736229 (0.00)
LogL	−1676067
Estimate using the maximum of probability 50,000 iterations	

Source: own calculations.

The estimates gave more or less satisfactory results. Indeed, two parameters C (1) and C (2), relating to the formation processes of the rents as C (3) post consistent estimates.

Knowing that C (3) represents the coefficient connecting the variation of the bubble compared to its last:

$$\Delta B_t = 0.699 * \Delta B_{t-1} \quad (1.42)$$

we can consider that:

$$B_t = 0.699 * \Delta B_{t-1} + B_{t-1} \quad (1.43)$$

where:

$$B_t = 0.699 * B_{t-1} + B_{t-1} - B_{t-2} \quad (1.44)$$

$$B_t = 1.699 * B_{t-1} - B_{t-2} \quad (1.45)$$

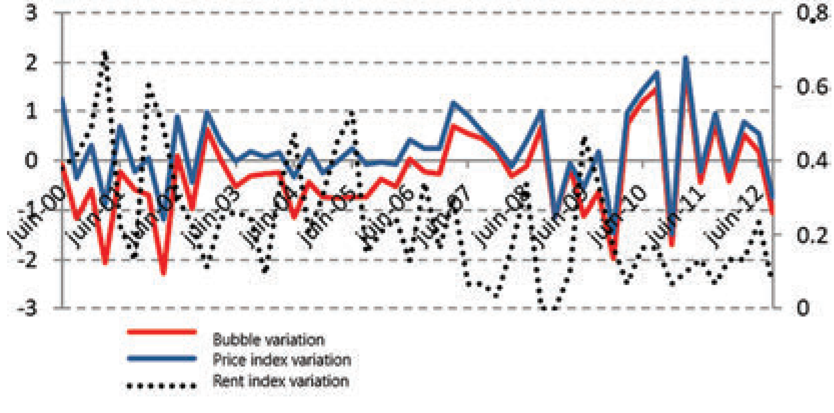
If a speculative bubble is characterized by a continuity in the belief in the rise and that the economic agents integrate this perception, then:

$$B_t > B_{t-1} > B_{t-3} \ldots > B_{t-n}$$

Speculative bubble tends to increase during the periods of rise of the prices, however in the event of deflation, it tends to drop under an average regime.

Graphically, it appears that the fundamental part, which normally explains prices on the real estate market seems to have a less important impact. By opposition, the bubble component largely explains the extreme movements of the real assets prices.

Figure 4. Presentation of the basic and speculative components of the real prices



Source: own calculations.

It proves that the development of the price index of the real assets is impacted by the development of the rents in Morocco. Indeed, the bubble component explains best the developments and the variations of the real assets prices. ANOVA analysis confirms this official report:

Table 11. Source of the variations of the real price index

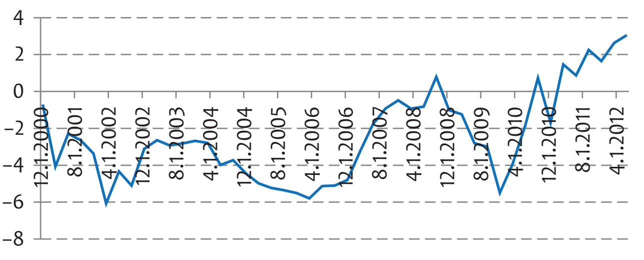
	Bubble	Rent index (fundamental component)
ANOVA Test	9.32 (0.00)	0.193 (0.66)

Source: own calculations.

The test of the variance affirms that the volatility of the real index is resulting mainly from the component bubble and that the development of the rent in Morocco contributes marginally to the variations of the real prices.

Within the period of 2000–2012 there were two series, in 2006–2008 and in 2010–2012 of significant price rises. Bubble during the period 2009–2010 can be explained by the negotiable instruments of the international financial crisis and its transmission into the Moroccan economy.

Figure 5. Development of the bubble on the Moroccan real estate market between 2000 and 2012



Source: own calculations.

Indeed, according to the formulation of Blanchard and Watson (1982) we can note that the bubble on the Moroccan real estate market takes the following form:

$$\begin{cases} B_{t+1} = B_t\left(\dfrac{1+0.5}{\pi}\right) + \mu_t & \textit{with probability } \pi \\ B_{t+1} = \mu_t \ , & (1-\pi) \end{cases} \tag{1.46}$$

Parameter μ is the average long run tendency and discount rate (capitalization) amounts to 50%. This bubble is determined using the model of Wu (1995) and characterized by an important degree of persistence according to the results obtained using the exhibitor of Hurst.

The exhibitor of Hurst "H" is a tool allowing measuring the persistence of a financial series while referring the calculation of statistics R/S "arranges over standard deviation". The latter is defined as being wide sums partial of the gaps of a time series to its average divided by its standard deviation.

The standard formalization of the R/S is:

$$R/S = \frac{MAX\sum_{i=1}^{n}(X_i - \bar{X}) - MIN\sum_{i=1}^{n}(X_i - \bar{X})}{\sqrt{\frac{\sum_{i=1}^{n}(X_i - \bar{X})^2}{n}}}$$

The majority of the studies (E. Peters, 1994) concluded that statistics R/S can be written in the following form:

$$R/S \cong n^h$$

whereN is the number of observations and H the exhibitor of Hurst. When we are in the presence of a random functioning (not persistence) H is equal to 0.5.

We can obtain H by recoursing to log the linear presentation of statistics R/S:

$$\log\left(R/S\right) = \mathrm{h} * \log(n) + \log(\mathrm{a})$$

- If H=0.5: independent system or a random walk;
- If 0.5<H<1: a strong persistence;
- If H<0.5: anti-persistent.

The result of the regression logarithmic curve of statistics R/S on the logarithm of time, in the case of the series of the bubble, is as follows:

$$\log\left(R/S\right) = 0.92^{(0.00)} * \log(N) - 0.37^{(0.00)} \tag{1.47}$$

The exhibitor of Hurst equals 0.92 what locates it in the interval 0.5 and 1 to indicate a strong persistence in the series of the bubble: if the series records a rise during the previous period, there are great chances that it maintains this pace. Thus, the bubble on the Moroccan real estate market is equipped with a long, capable memory to confirm the spreading of the latter. The events which occur at one moment given, for example the explosion of the bubble, tend to affect the future trend of the series[14].

5. Speculative bubbles cycles

The cycle of the speculative bubbles have a seminal importance for the monetary and financial regulation policies. Indeed, the determination of the moments when the prices start to post deformations compared to the fundamental value makes it possible for the authorities to manage to reduce the volatility of the prices and set up of the policies to rationalize the market pricing and in particular that of the real estate.

Several work suggested using Markov switching model to test the phases of boost and bust of the bubbles. The characteristics of these model lies in its capacity to describe in an empirical way the phase's boom and depression of the assets prices. Criticism formulated by Evans (1991) on the cyclical nature of the bubbles constituted a catalyst for this type of work which tries to identify the regimes of the speculative bubbles.

According to methodology of Rock (2001) and Kim et al. (2011), the duration of bubble cycle is detected through the use of the Markov switching model with change, which makes it possible to approximate the probability of supervening of the various involved regimes.

The model is characterized by its capacity to detect heterogeneous states of the world. Further in the paragraph, we propose a short description of these models, however, for more details, see work of Hamilton [1994], Kim and Nelson [1999] and Wang [2003].

The simple process is considered as:

$$y_t = \mu_{s_t} + \varepsilon_t \tag{1.48}$$

Parameter s_t are the states through which the stochastic process passes during its existence, ε_t is a Gaussian white noise and μ makes it possible to detect the transition between the various states from the endogenous variable.

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[14] According to E. Peters "Fractal Market Analysis", (1994), this persistence indicates a sensitivity to initial conditions to feed the assumption according to which the agents will tend to have irrational behaviors while continuing to believe for one long life in the rise of the prices.

In this case, depending on the states of the world of "there" we obtain different securities with regard to the expectation μ as from the moments of the residues of the equation.

If it is supposed that the world knows only two states, first and second, for this purpose, the system can look as follows:

$$y_{1t} = \mu_{s_1} + \varepsilon_{1t}\text{: first state}$$

$$y_{2t} = \mu_{s_2} + \varepsilon_{2t}\text{: second state}$$

where:

$$\varepsilon_{1t} \sim (0, \sigma_1^2) \text{ et } \varepsilon_{2t} \sim (0, \sigma_2^2)$$

This formulation induces clearly that the two processes y_1 and y_2 are different. When we are in state 1 then the expectation of y1 and μ_{s_1}, while the state 2 fact of arising describe by μ_{s_2}.

The variances of the residues, forwarded in each process, describe predictive uncertainties of the model in each state of the system. In other words, the variances of the residues of the models describe volatilities of each state of the system, for example, for first state we could have higher volatility compared to that of the second's state.

The characteristics of the models with Markovian change is their capacity to collect the transitions from a given state to another. Simply, the proposal of the Markov switching model is to consider that the presence of state 1 is related to the presence or a realization of an exogenous variable (X) and the transition towards another state is provided in the event of absence of this variable. Thus, if we are in a deterministic situation we note that:

$$y_t = D\left(\mu_{s_1} + \varepsilon_{1t}\right) + (1-D)\left(\mu_{s_2} + \varepsilon_{2t}\right) \tag{1.49}$$

D is equal to the unity in the event of presence of the variable x>0 and zero differently.

In the case of Markov models, the regime change is stochastic. This means that there is a possibility of forwarding of one regime to another. However, the dynamics of the process of change is regarded as being known and generated via a matrix of transition. The latter controls the probabilities of change of a state with another and takes the following form:

$$P = \begin{pmatrix} p_{11} & \cdots & p_{1k} \\ \vdots & \ddots & \vdots \\ p_{k1} & \cdots & p_{kk} \end{pmatrix} \tag{1.50}$$

In the matrix of transition, the probability (p_{ij}) makes it possible to approximate the chances to forward a state to another one. For the case where we see forwarding of a state 1 in a state 2 the probability of transition would be p_{21}, while the probability of persisting in state 1 is qualified of p_{11}. Within the forwarded framework, the probabilities of transition are regarded as being stationary, which is not always the case. In the presence of probability varying in time another type of models is used like Markov regime.

The estimate is carried out according to two steps in fact: the Bayesian approach or method of maximum likelihood. However, the second approach is mostly used with the detriment of the first. For a regime in two states in the form $y_{1t} = \mu_{s_1} + \varepsilon_{1t}$, the function of maximum likelihood is:

$$lnL = \sum_{t=1}^{T} \ln\left(\frac{1}{\sqrt{2\pi\sigma^2}} \exp\left(-\frac{y-\mu}{2\sigma^2}\right)\right) \tag{1.51}$$

If the states of the world are then well defined, it is enough to maximize likelihood to have the parameters μ and σ^2 for each state of the system, however and what relates to the model of Markov, these states are unknown. For this purpose, it is necessary to amend the function of probability to take account of the absence of an exact knowledge of the state of the system in question. It is noted that:

$$lnL = \sum_{t=1}^{T} ln \sum_{j=1}^{2} \left(f\left(y_t \mid S_t = j, \varphi\right) \Pr(S_t = j) \right) \tag{1.52}$$

In order to maximize the function of probabilities, it is necessary to know the probabilities of transition, from where we can recourse to the filter of Hamilton which makes it possible to initialize the probabilities of transition and to determine them according to an iterative process (see James Hamilton, 2005).

For the case of the Moroccan real estate market, the results obtained in the preceding section confirm the presence of a speculative bubble. Indeed, prices indicate the presence of a component other than that fundamental, whose quantification was carried out using the Kalman filter.

In this section and using the model of Markov, it is proposed to measure the dating of the bubbles by specifying their birth date and also their date of deflation. It should thus make it possible to detect the phases of ascending and dropping prices.

By adopting the formulation of Blanchard et al. (1982), we consider that bubble formation process has two phases: first – ascending phase and second – depression.*

$$\begin{cases} B_{t+1} = B_t\left(\dfrac{1+r}{\pi}\right) + \mu_t \\ B_{t+1} = \mu_t \ , \ (1-\pi) \end{cases} \tag{1.53}$$

With r the rate of capitalization and π probability of birth of the bubble.

In this case and by using the model of Markovian regime change we can estimate both states of the bubbles according to the following formulation:

$$\begin{cases} B_{1t} = \mu_{s_1} + \varepsilon_{1t} & , \pi \\ B_{2t} = \mu_{s_2} + \varepsilon_{2t} & , (\pi - 1) \end{cases} \tag{1.54}$$

The first state is relative to a speculative bubble boom, during which the prices tend to increase, while the second state describes the depression phase or the bubble with tendency to burst itself under the negotiable instruments of the fall of the prices.

The model with change with Markovian regimes used makes it possible to approximate two types of states. The estimates using the maximum likelihood made it possible to lead to the following results:

Table 12. Identification of the Markov regimes

States	Mean	variance
Boost (E2)	0.047453 (0.09)	2.118854 (0.00)
Bust (E1)	–3.903149 (0.00)	1.290944 (0.01)
LogL:–89.6689, the estimates were carried out by supposing the normal distribution.		

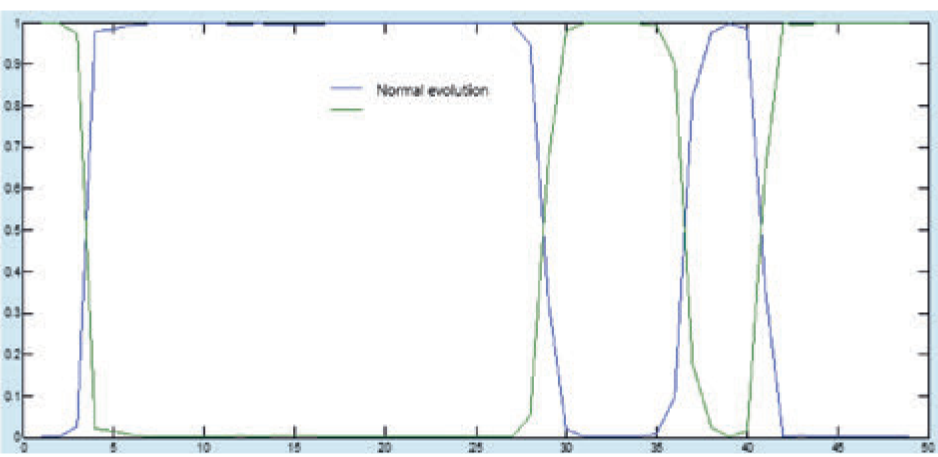
Source: own calculations.

According to the results obtained we get two types of bubbles on the Moroccan real estate market, first positive whose average rise equals 0.04 and second phase of falling prices equaling –3.9. Moreover and according to the analysis of the variance (volatility) of the two states, it arises that the phase of fall of the prices is less volatile than this rise phase. This can be explained by the fact when the market with high volatility in reason of the request of the purchasers of good, against the depression cycle that been often interpreted by weakened volatility.

The most interesting in terms of analysis using the model with Markovian regime change, is the production of the matrix of probability of transition from a regime to another "D". The results obtained confirm that; when we are in first state (E1) we have a probability of 93% of persisting there and 6% chance to forwarding towards a bull regime when a speculative bubble is being born. However, when we are in the second state of rise of the prices we have only 89% chance that the bubble persists, while there is 11% probability of returning to the first state.

$$Matrix\ of\ transtion\ probabilities = \begin{bmatrix} 0.93 & 0.11 \\ 0.07 & 0.89 \end{bmatrix}$$

Figure 5. Probabilities of transition from a normal state in an explosive state of the real estate bubble between 2000 and 2012



Source: own calculations.

The analysis of the development of the probability of supervening of an explosion of a bubble indicates that the frequency of formation of bubble is very limited. There existed only two periods which were affected by a rather important explosion of the prices. Euphoria lasted only for one more or less short period of six and nine quarters. Below table emphasizes the obtained results:

Table 13. Duration of bubble cycles

States	Expected duration
Boost (E2)	9.11 quarters
Bust (E1)	14.55 quarters

Source: own calculations.

The explosion of the bubble during the periods 2006–2008 coincides with the beginning of the credit boom in Morocco. Growth rate at that time was two-digit pumping money especially into real estate market.

The analysis signifies strong correlation between bank credit and the real estate bubble, which is shown in Table 14.

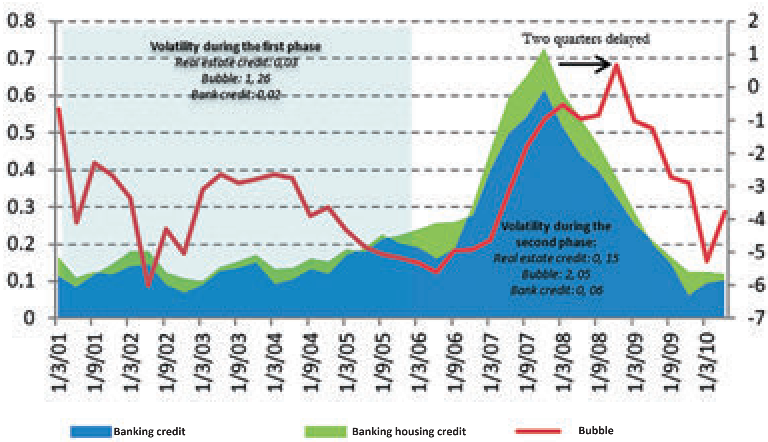
Table 14. Correlation between the development of the bank credits and the real estate bubble

Lag	0	1	2	3
Correlation	38.13%	**46.72%**	**52.71%**	44.32%

Source: own calculations.

Figure 6 shows this dependence in a graphic manner. The rise of the real prices lasted two quarters after the beginning of the boom of the credit. This confirms that the increase in lending is among the principal determinants of the bubble of 2006–2008.

Figure 6. Development of the bank credits, the real estate credits and the real estate bubble between 2001 and 2010



Source: own calculations.

6. Macroeconomic factors and simulation model

In order to collect the macroeconomic and financial variables likely to influence the formation of speculative bubbles, an analysis of the econometric relations is carried out. The variables used in this analysis are: GDP growth, the market index of the Moroccan market, interbank interest rate, the credit with the economy, inflation and rate of exchange. The choice of these variables is justified by their informational effect on the conditions of the real estate market.

The evolution of the growth, interest rates and the index of the profitability of the MASI indicate the effects of the threshold which can be pro-cyclical. Moreover, the introduction of credit aims at measuring the power of the banking system to cause the speculative bubbles. Factors of the threshold intervene by increasing the risk of collapse and by indicating more important prospects for growth. On the one hand, the powers of action constitute factors of amplification for the financial system and produce an optimism towards the future.[15].

The following general formulation was retained:

(1.55)

With:
B_t: bubble process;
$Loan_t$: credit growth cycle;
$MASI_t$: rentability of MASI index;
$TPIB_t$: real growth of GDP;
TMP_t: interbank interest rate;
$REER_t$:: real exchange rate;
INF_t: inflation rate;
ε_t: error of model (normal distribution).

We obtained following results[16]:

Table 15. Estimation results

Variable	Coefficient	Probability
B(-1)	1.058430	0.0000
Loan(-1)	30.03110	0.0000

[15] The factors of the threshold are factors or variables which begin a financial cycle, whereas the factors of the lever are those which accentuates the rise in him (see Al of Hanschelet (2005), Rouabah (2007)).

[16] The estimates were carried out with the SURE method to correct the problems heteroscedasticity.

Variable	Coefficient	Probability
INF(-1)	38.36959	0.0000
PIB(-2)	16.76442	0.0015
REER(-4)	−34.19129	0.0000
TMP	−60.95996	0.0000
RM(-3)	4.211852	0.0054
R-squared	0.623068	0.553633
Scale	1.027847	1.056470
R-squared statistic	309.7109	0.000000

Source: own calculations.

The estimates were carried out using the method of least squares quasi-generalized in order to circumvent the problems of heteroscedasticity of the residues. The ex-post evaluation confirmed the validation of the model with coefficients of determination largely higher than 60%. Moreover, bootstrap technique simulations (between 10,000 and 50,000 repetitions) were adopted in order to validate the statistical properties of the parameters of the three models. The results obtained confirm the stability of the various parameters of interest.

The parameters obtained affirm that:

- The growth positively influences the birth of bubble on the Moroccan real estate market. Owing to the fact that the improvement of the economic conditions makes it possible to install a climate of trust in the investors.
- The positive development of the stock market is also a signal in favor of the formation of the bubbles since the investors in this market are likely to positively influence the profitability of the companies and the sectors connected with the real estate.
- Interest rate influences the birth of bubbles positively. This can be explained for the case of Morocco as follows: when the economic agents note that interest rates tend to increase on the market, they start to modify their wallet by seeking alternative investments like the real estate. This is true for the class of the investors who use proper funding sources.
- Contrary to the bank credit, we obtained a positive relation indicating that the availability of the bank financing allows booster rocket the prices on the real estate market.
- Rise of inflation has a negative impact. It can be explained by the fact that rising prices reduce purchasing power of households and investors. Also, rising inflation stipulates increase of interest rates thus making possible a reduction of the prices on the real estate market because of diminishing demand.

For the simulation exercise of the evolution of bubble in real estate market, one adopted the following step: the development of univariate temporal models makes it possible to predict the evolution of the factors of threshold and lever included in the models, and secondly, using a model of simulation, forecasts the future trend of bubble. This exercise makes it possible to know how the evolution of the economic and financial conditions will be able to influence the dynamics of the bubbles. We chose a fan chart in order to take account of uncertainty related to this stimulation exercise.

The simulation system has a following form:

$$B_t = \beta_4 B_{t-1} + \beta_1 (INF_t) + \beta_2 MASI_t + \beta_3 TPIB_t + \beta_4 TMP_t + \beta_4 REER_t + \beta_1 (Loan_t) + \varepsilon_t$$

$$INF_t = c_1 + \sum_{i=1}^{p} \alpha_i (INF)_{t-i} + \varepsilon_t$$

$$TPIB_t = c_2 + \sum_{i=1}^{p} \beta_i (TPIB)_{t-i} + \zeta_t$$

$$TMP_t = c_3 + \sum_{i=1}^{p} \gamma_i (TMP)_{t-i} + v_t$$

$$MASI_t = c_4 + \sum_{i=1}^{p} \phi_i (MASI)_{t-i} + \xi_t$$

$$REER_t = c_4 + \sum_{i=1}^{p} \phi_i (REER)_{t-i} + \sigma_t$$

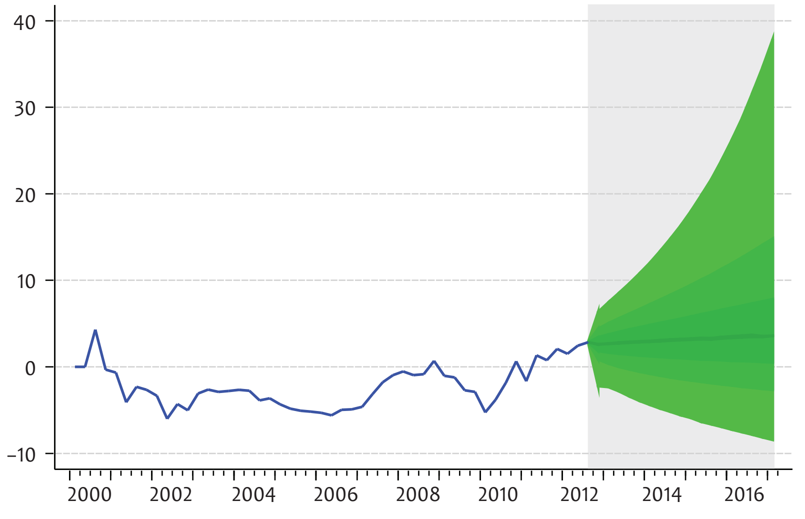
$$loan_t = c_4 + \sum_{i=1}^{p} \phi_i (loan)_{t-i} + \tau_t$$

with

$(\varepsilon_t, \varsigma_t, v_t, \xi_t, \sigma, \tau)$: white noises.

The equations of exogenous dynamics were estimated through the use of the ARMA processes. We used stochastic simulation (50,000 iterations were carried out). The results obtained are summarized in the following figures which represent the central forecast and the associated confidence interval. These forecasts are spread out until the second quarter of 2012. To present simulations of the possible trajectories according to the evolution of macroeconomic and financial conditions, we chose the fan chart to describe uncertainty related to future projections.

Figure 7. Fan chart of bubble process



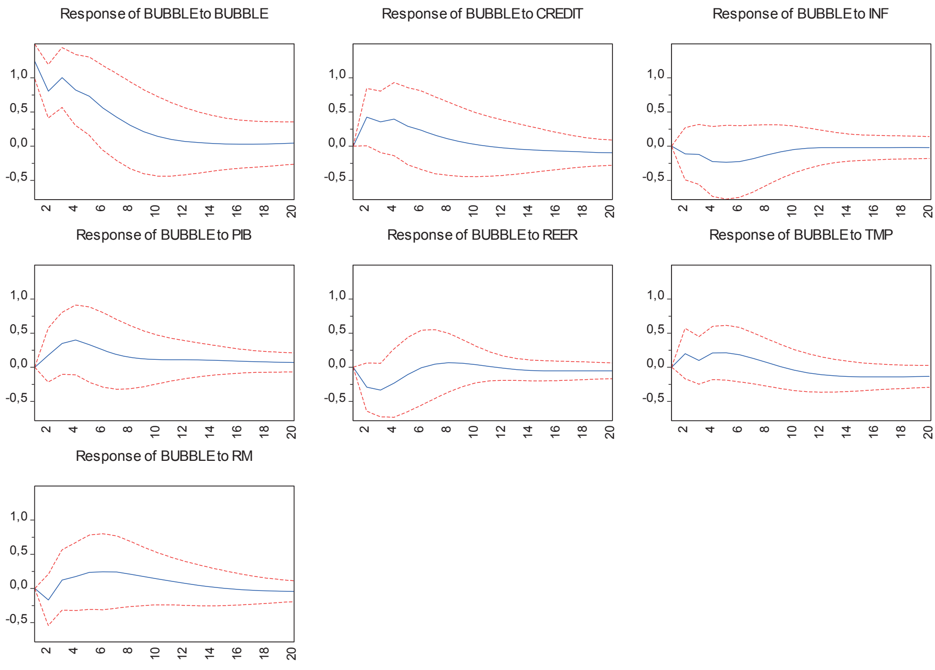
Source: own calculations.

Thus, the analysis of projections emphasizes a central scenario according to which the bubble will continue to stagnate during four years of forecast. In addition, there is more probability that the tendency of the bubble will begin again with the rise (the bullish tendency of the fan chart). On the other hand, the inversion of the price trend towards a bear cycle is less probable, if the economic and financial conditions remain stable.

The fact that the bubble formation process is influenced by the macroeconomic and financial factors, it is possible to advance that the economic policies can intervene to control the trend of prices. In this direction, we could use VAR model to measure the potential effects of the economic shocks on the process of speculative bubbles.

The results obtained confirm that the interest rate shock will have positive effect on the formation of the bubbles. Indeed, any increase in interest rates on the market will increase prices on the real estate market, which confirms the refuge character of this investment. In addition, increasing inflation would result in a fall of the real prices because of the arbitration carried out by the households with regard to consumption and the investment. Shocks relating to the economic growth and the bank credits have a positive effect on the bubbles formation process. This is explained mainly by the future potential of the Moroccan economy and also by the income increase of households.

Figure 8. Response of bubble process to shocks



Source: own calculations.

Conclusions

The objective of this paper is to present several steps suitable for checking for the existence of speculative bubble on the Moroccan real estate market. Due to the lack of data on a series of the real assets prices, the price index of the real assets was used to confirm or deny the existence of a speculative bubble. Two approaches were recommended, namely: a statistical approach and a structural approach. The first methodology uses statistical tests suggested in the theoretical and empirical literature resting on the identification of the explosive character of the series of the prices and the fundamental value. In addition, the structural approach is based on a theoretical definition of the bubble and various Euler-based tests.

Results obtained confirmed that the real assets prices deviate significantly from the fundamental value, whose explanatory capacity is less important. For this reason, a speculative bubble characterized the development of the real assets prices during the period 2006–2008. In addition, the analysis of the dating of the bubble on the real estate market lets one predict the existence of two regimes which control the formation of the speculative bubble. The first state describes a period of rise of the prices, an explosion of the bubble, and a second state is characterized by a return to a normal or average state. Based on the results obtained using the Markovian regimes we can affirm that the criticism of Evans (1991) on the cyclic nature of the financial bubbles is confirmed. Indeed, the explosion of the bubble on the Moroccan real estate market lasts about nine quarters and the normal cycle lasts fourteen quarters. Each cycle is followed by another and so on.

One of the factors that contributed to a rise of a real estate speculative bubble in 2006–2008 was the credit boom (there was a shift of two quarters). Easing of the conditions of granting credit during this phase positively fed the beliefs of the economic agents acting on the real estate market, until a certain consensus was formed on the continuity of the trend of the real prices, resulting in a bubble on the market. The anticipation that characterized the market throughout 2 years to return to a normal situation, after the transmission of the crisis to the Moroccan economy. However, the analysis of the trends of real prices and the speculative bubble, allows to predict further discord between prices and fundamentals and a continuation of the bubble. In order to avoid a radical deflation of the bubble and a future crash on the real estate market, government should consider introducing preventive policies.

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Chapter 16

"Down the rabbit-hole": Does monetary policy impact differ during the housing bubbles?

Tomas Reichenbachas[1]

"What a strange world we live in… Said Alice to the Queen of hearts <…> it would be so nice if something made sense for a change."
– Lewis Carroll, Alice in Wonderland

Introduction

Alice, the well-known fictional character from Lewis Carroll's (1865) novel "*Alice's Adventures in Wonderland*", went "down the rabbit-hole" to find herself in a strange world in which different (and quite bizarre) laws existed. Extending the parallel to modern economic and financial world, central banks recently found themselves in a strange reality where previously widely accepted theories about economic laws and seemingly well thought-out policy responses do not necessarily work any longer. Under unusual economic circumstances, policy makers are prone to policy mistakes if they base their policies on the analysis of a qualitatively different state of the economy. One notable example of such policy errors was policy makers' reliance on pre-crisis estimates of fiscal multipliers in their evaluation of possible effects of contractionary fiscal policy. Fiscal multipliers turned out to be very large in the wake of deep economic and financial crisis and the negative effects of austerity policies were considerably higher than expected[2].

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[1] Lietuvos bankas and Vilnius University.
The views expressed herein are solely those of the author and do not necessarily reflect the views of the Bank of Lithuania.

[2] See Auerbach et al. (2012) for discussion.

Yet, most models are built on implicit assumptions about one single state of the economy, which emanates from economists' desire to have linear and, thus, tractable models. Nevertheless, the recent crisis experience confirms that changes in regimes need to be taken seriously. As Hamilton (2016) summarizes this, the convenience of linear models is not a sufficient cause to maintain that no fundamental changes in economic dynamics occur when the economy goes into a different state. This view is gaining popularity in theoretical and empirical literature. For example, there is a growing body of literature analyzing possible regime changes in monetary policy transmission: pre-Volcker and post-Volcker monetary policy (Murray et. al. (2015)), monetary policy under the zero-lower-bound constraint (Hirokuni (2016)), monetary policy during financial stress (Hubrich et. al. (2014)), etc.

Asset price boom and bust periods constitute diametrically opposite regimes, which have huge implications for the state of the overall economy and the impact of economic policies. Asset price bubbles regained attention of academic economists and policy makers alike after the recent global financial crisis but this is by no means a new problem, as was convincingly argued by Reinhart and Rogoff (2009) in their seminal book *This Time Is Different*. It is well documented that many countries have distinctive housing price cycles, which exhibit, among other things, long phases of persistently high and low volatility (see, e.g., Ceron et al. (2006) and Corradin et al. (2013)). Turning points and phases of those cycles (and financial cycles, more generally) can be hard to predict in real time, though some simple indicators, such as housing price-to-income ratios and credit-to-GDP gaps are demonstrated to have some predictive power (see Behn et al. (2013)).

While asset price bubbles are recurring phenomena and constitute an age-old problem to policy makers, it is still not so clear if and how central banks should react to those bubbles. Ironically, some authors (BIS (2014)) attribute at least part of the blame for fueling recent housing bubbles in developed countries to overly loose monetary policies. This can also be seen in the context of broader "leaning with or against the wind" debate (see, e.g., Svensson (2014)). Proponents of "leaning against the wind" policies advocate a monetary policy that is somewhat tighter than what is consistent with flexible inflation targeting without taking any effects on housing prices into account. This view rests on the implicit assumption that the size of the bubble component should decline in response to an exogenous increase in interest rates. However, this may not necessarily be the case. Galí (2014) and Galí et al. (2015) demonstrate that monetary policy can have an opposite effect: the prices can end up increasing persistently in response to an exogenous tightening of monetary policy.

Notably, many authors (see, e.g., Gattini et al. (2010)) still treat asset price bubbles as some stochastic deviations of market prices from their fundamentals but there have been attempts to analyze these bubbles as separate regimes[3] (Corradin et al. (2013)). We take the latter approach and try to identify bubble episodes as separate economic regimes characterized by different economic regularities. We contribute to the "leaning-against-the-wind" discussion by analyzing whether the economic impact of monetary policy differs during the housing-booms as opposed to "normal" times. From methodological standpoint, we argue that a single-regime linear vector autoregressive model, which is mostly used to analyze the monetary policy effect on credit and housing markets (see Iacoviello et al. (2008) and Musso et al. (2011)), cannot accurately capture the economic dynamics during the housing price bubbles and normal times. To account for these nonlinearities we build a Markov-switching vector autoregressive models[4] for five countries with an independent monetary policies. Since in our set-up we include both credit and housing markets, we are able to capture the different regimes in housing markets. We find some evidence that during such bubble episodes the impact of monetary policy and certain other shocks on the economy is distinctly different than during normal times.

1. Literature overview

Our paper is related to literature in the area of monetary policy, credit, housing market and asset price bubbles. The literature in those fields has been developing very actively, therefore we will not try to discuss every separate paper in detail, but rather try to lay out the main ideas from different strands of the related literature and from seminal papers of the respective fields.

Monetary policy shocks with credit market and asset prices. A number of studies tried to include credit and housing variables in traditional structural vector autoregression (SVAR) models used in monetary policy analyzes (see, e.g., Musso et al., (2011); Iacoviello and Minetti, (2008); Elborne, (2008)). Incorporating the housing market is crucial for the identification of monetary policy shock transmission

3 This approach is quite intuitive: during "normal" times housing prices are determined by interacting rational agents, which care about fundamental valuations, whereas during bubble episodes prices are driven by exuberant adaptive expectations (trend following). In other words, there can be periods of "greater-fool bubbles" (see Kindleberger (2000) for some evidence of "greater-fool bubbles" and Conlon (2015) for a more general discussion on causes of price bubbles).

4 The result is, of course, based on the premise that the imposed Markov-switching structure is an adequate representation of the data, which remains an open question.

channels, since a large fraction of credit flows is directed specifically into the real estate and residential housing markets. Iacoviello and Minetti, (2008) have analyzed a credit channel as part of monetary policy transmission mechanism in four European countries. Their results suggest that, despite the process of integration, residual heterogeneity characterizes European housing and credit markets and eventually the transmission mechanism of monetary policy.

Macroeconomic regimes and regime shifts. From methodological perspective our paper is closely related to the strand of literature which maintains the possibility that the economy can be in different states and focuses on the differences of impact of structural shocks in the distinct regimes. For example, Lhuissier (2017) shows that the differences in the behavior of the economy between tranquil and financial distress periods (e.g., the Great Recession and the euro zone sovereign debt crisis) reflect variations in the transmission mechanism of credit supply shock. The transmission of credit supply shocks to the economy appears strongly non-linear over time: in periods of financial distress, these disturbances are the most important shock driving the business cycle fluctuations, while their effects are negligible in tranquil periods. However, in a more general sense, regime-switching model in most cases lacks the theoretical justification for different regimes. Even if from empirical perspective one can find that economy is governed by few separate regimes, it is also necessary to have theoretical justification and economic logic behind the regimes (see for example Baele et al. (2015)). In any case, there is a growing body of literature analyzing possible regime changes in monetary policy transmission: pre-Volcker and post-Volcker monetary policy (Murray et. al. (2015)), monetary policy under the zero-lower-bound constraint (Hirokuni (2016)), monetary policy during financial stress (Hubrich et. al. (2014)), etc.

Regime switches in monetary policy. Bernanke and Mihov (1998) proposed the structural VAR model with a regime-switching monetary policy block to analyze the effects of monetary policy. They apply the regime-switching approach, proposed by Hamilton (1990), to a (just-identified) model of the market for bank reserves to allow for regime-switching Fed responses to shocks to the demand for total reserves and non-borrowed reserves. Their model's regime switches correspond closely to the well-known "Volcker experiment" with non-borrowed reserve targeting during the 1979–82 period, and an operating regime focused on interest rates with little attention to reserve aggregate smoothing outside of the 1979–82 window. The results of Bernanke and Mihov (1998) are supported by Sims and Zha (2006) paper. Sims and Zha (2006) identify monetary policy shocks by allowing for simultaneity and regime switching in coefficients and variances for the US case. The best fit among versions that allow for changes in equation is given by the one that allows coefficients to change only in the monetary policy rule. This model allows switching among four regimes of which three main regimes correspond roughly to periods when most observers believe that monetary policy actually differed.

Asset prices and regime shifts. There are some attempts to identify the possible regimes that affect asset prices. Ceron et al. (2006) in their paper examine the experience of fourteen developed countries. House price dynamics was modelled as a combination of a country-specific component and a cyclical component, which is a two-state Markov-switching process with parameters common to all countries. Ceron et al. (2006) find that the latent state variable captures previously undocumented changes in the volatility of real housing price increases. These volatility phases are quite persistent (about six years, on average) and occur with about the same unconditional frequency over time. Corradin et al. (2013) examine the house price dynamics for thirteen European countries. They estimate the Markov-switching error correction model on house price returns at the country level, with deviations between house prices and fundamentals feeding into the short-run dynamics. Corradin et al. (2013) find, that house price returns in Europe are generally characterized by three (high, medium and low) phases; growth rates within regimes differ largely across countries. Nneji et al. (2013) apply a three-regime Markov switching model to investigate the impact of the macroeconomy on the dynamics of the residential real estate market in the US. This allows them to identify "boom", "steady-state" and "crash" regimes in real estate market.

Housing price bubbles and monetary policy. To the best of our knowledge, there are just two attempts (Simo-Kengne et al. (2013) and Chang et al. (2011)) to analyze the differences of monetary policy shocks during different housing price regimes. Simo-Kengne et al. (2013) examine asymmetries in the impact of monetary policy on the middle segment of the South African housing market. They use Markov-switching vector autoregressive model in which parameters change according to the phase of the housing cycle. They find that the impact of monetary policy is larger in the "bear-regime" than in the "bull-regime"; indicating the role of information asymmetry in reinforcing the financial constraint of economic agents. Chang et al. (2011) utilize the MS-VAR approach to analyze the impact of monetary policy on housing returns for the US. Though this paper does not provide a clear identification of the housing cycle they indicate that, following an innovation in Federal Funds rate, housing returns decline substantially more in low-volatility regime than in high-volatility regime.

2. Identifying housing price bubbles: some descriptive statistics

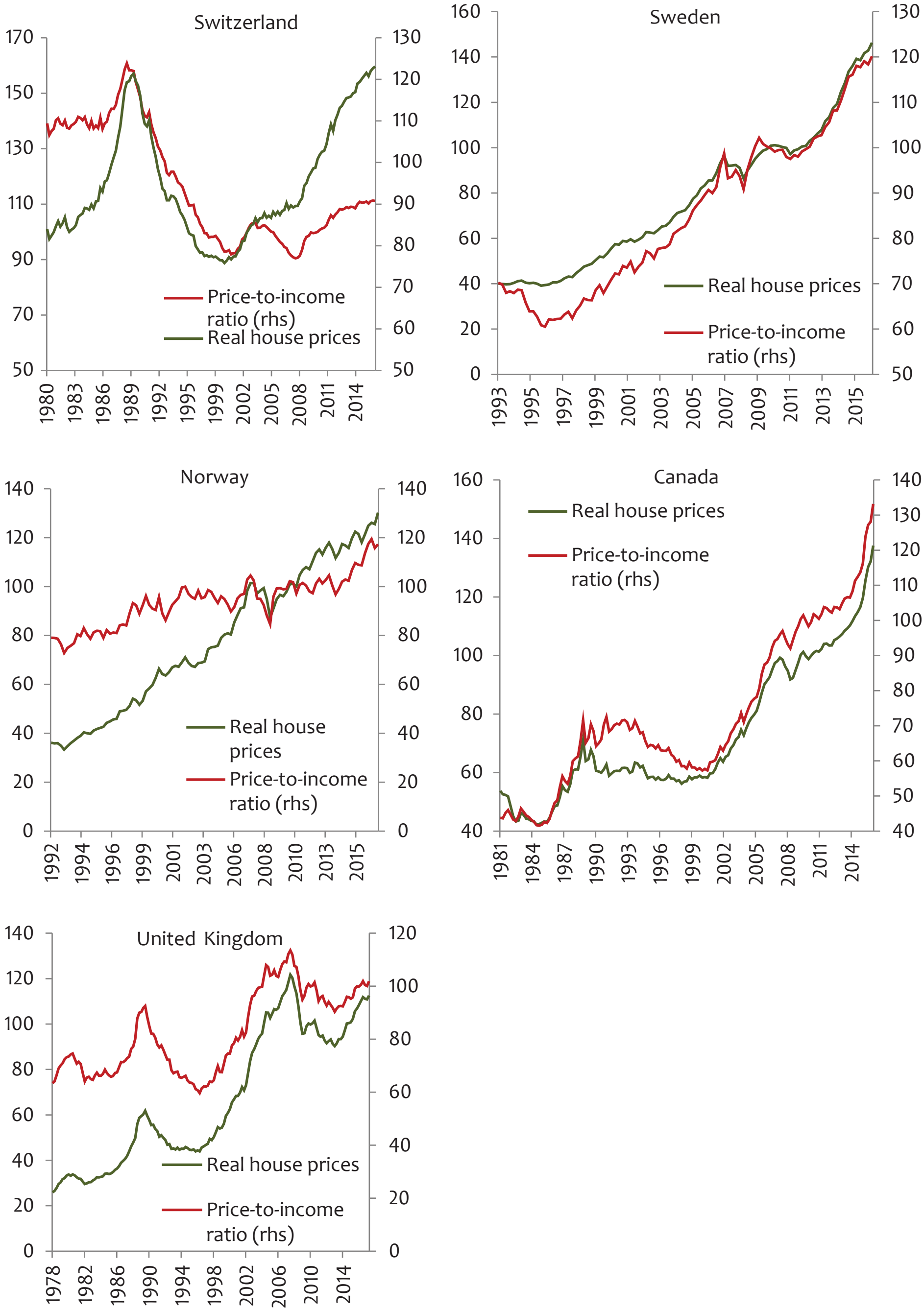
Asset price boom and bust periods constitute diametrically opposite regimes, which have huge implications for the state of the overall economy and the impact of economic policies. Asset price bubbles regained attention of academic economists and policy makers alike after the recent global financial crisis but this is by no means a new problem, as was convincingly argued by Reinhart and Rogoff (2009) in their seminal book *This Time Is Different*. It is well documented that many countries have distinctive housing price cycles, which exhibit, among other things, long phases of persistently high and low volatility (see, e.g., Ceron et al., 2006 and Corradin et al., 2013). However, while asset price bubbles are recurring phenomena, it is still not so clear how to identify them. Turning points and phases of asset price cycles (and financial cycles, more generally) can be hard to predict in real time, though some simple indicators, such as housing price-to-income ratios and credit-to-GDP gaps are demonstrated to have some predictive power (see Behn et al., 2013). European Systemic Risk Board (ESRB, 2015) shows that price-to-income ratio indicator is pro-cyclical: it increases prior to a crisis as house prices grow faster than average per capita disposable income, and reverts abruptly after the onset of the crisis. Many authors find that housing price bubbles are, in most cases, related to credit booms. This tendency stipulated the idea of financial cycles (Drehmann et al., 2012).

Drehmann et al. (2012) in their seminal paper highlight few key empirical conclusions about the financial cycles:

- First, when seeking to identify financial cycles most relevant for macroeconomic disruptions, it is critical to focus on the medium term, not on traditional business cycle frequencies i.e., on cycle lengths of sixteen years on average, or even longer[5].
- Second, it is possible to identify well-defined (medium-term) financial cycles, whose peaks tend to coincide very closely with financial crises and, hence, with serious damage to economic activity.
- Third, those cycles are best captured by combinations of credit and property prices; equity prices do not fit the picture well.
- Fourth, the length, amplitude and virulence of these cycles have increased since the mid-1980s.

[5] Medium-term cycles last between 8 to 18 years, with their length varying across variables. Credit has the longest medium-term cycle (18 years), and equity prices the shortest (9 years).

Figure 1. Real house price index and price-to-income ratios



Source: Own calculations based on Bank of International Settlements and FRED data.

In our paper we analyze five countries: Switzerland (CH); United Kingdom (UK), Sweden (SE), Norway (NO), Canada (CA). Figure 1 provides the price-to-income ratios, and real house price data of those countries. As we can see from Figure 1, there is some clear heterogeneity across countries. We can observe some undoubtedly cyclical tendencies in the United Kingdom, Switzerland and Canada. However, in Norway and Sweden data no clear cyclical movements appear. This – at least partly – can be explained by the data sample used. Sweden experienced the housing bubble in late 90s, which burst in 1992 (this is the start of our data sample) (see Drees et al. (1998)). Norway experienced a housing bubble in mid-80s, which burst in 1989 before the start of our data sample). For other countries (Switzerland, United Kingdom and Canada) our data sample captures at least one full housing cycle. In Switzerland we can see the boom phase – the rising real housing prices, and price-to-income ratios in the mid of 90s – followed by the bust in 1989 and a prolonged decline of real house prices. In the United Kingdom we see the increase in housing prices in late 90s, and before the 2008 financial crash. In Canada we observe the rising prices in late 90s and a burst in 1989. These bubbles are well documented in the literature.

It is crucial to note that the data are not necessarily fully harmonized. We use housing price data from Bank of International Settlements (BIS). However, cross-country analysis of house price data presents a number of statistical challenges. Property price indicators can differ in three principal dimensions: their geographical coverage, the source of information on property values, and the approach to controlling for differences in property characteristics (see ex. Scatigna et al., 2014 for more details on data, and Ghysels et al., 2013 for more general discussion about data issues in real estate sector).

3. The methodology

3.1. Markov-switching structural Bayesian VAR

Following Sims and Zha (2006), Sims et al. (2008) and Lhuissiers (2017), in our paper we use the Markov-switching structural VAR models to capture regime-switching in real estate market. The model can be expressed in following form:

$$y_t' A_0(s_t) = \sum_{i=1}^{p} y_{t-1}' A_0(s_t) + C(s_t) + \varepsilon'_t \, \Xi^{-1}(s_t), \; t = 1, \ldots, T. \tag{1}$$

where y_t is a vector of endogenous variables. We assume that ε_t follows the following distribution:
$p(\varepsilon_t|Y_{t-1}) = normal(\varepsilon_t|0_n, I_n)$. n is the number of endogenous variables, 0_n denotes an $n \times 1$ vector of zeros, I_n denotes the $n \times n$ identity matrix, and $normal(x|\mu,\ \Sigma)$ denotes the multivariate normal distribution of x with mean μ and variance Σ. T is the sample size; $A_0(s_t)$ is a n-dimensional invertible matrix under the regime s_t; $A_1(s_t)$ is a n-dimensional matrix that contains the coefficients at the lag i and the regime s_t; $C(s_t)$ contains the constant terms; $\Xi(s_t)$ is a n-dimensional diagonal matrix.

For $1 \le i,\ j \le h$, the discrete and unobserved variable s_t is an exogenous first order Markov process with the transition matrix Q:

$$Q = \begin{bmatrix} q_{1,1} & \cdots & q_{1,j} \\ \vdots & \ddots & \vdots \\ q_{i,1} & \cdots & q_{i,j} \end{bmatrix} \tag{2}$$

where h is the total number of regimes; and $q_{i,j} = \Pr(s_t = i \,|\, s_{t-1} = j)$ denote the transition probabilities that s_t is equal to i given that s_{t-1} is equal to j, with $q_{i,j} \ge 0$ and $\sum_{j=1}^{h} q_{i,j} = 1$. When implementing k-independent Markov-switching processes, $s_t = \left(s_t^1, \ldots s_t^k\right)$, the transition matrix Q, becomes $Q = Q^1 \otimes \ldots \otimes Q^k$, where Q^k is an $h^k \times h^k$ matrix. When estimating our model we closely follow Sims and Zha (1998) paper and employ the Litterman's random-walk priors to structural-form parameters.

In our baseline specifications y_t is constituted by 5 variables ($y_t \equiv$ $\equiv [ip_t, p_t, r_t, cre_t, hpi_t]$), where ip_t is the logarithm of the quarterly real GDP, p_t is the logarithm of the Consumer Price Index, r_t is the policy rate (i.e., respective interbank lending rate), cre_t is the logarithm of the quarterly real household credit; and hpi_t is the logarithm of the quarterly real house price index. Data are derived from the BIS (for credit and housing series) and OECD databases (for other series). Based on the lag-length selection criteria, we set the lag order to ρ=4. Based on Drehmann et al. (2012) we set the prior duration of each regime to 10 years (40 quarters).

3.2. Identification

In order to decompose the time series variation into mutually independent components (structural shocks) we should impose some specific restrictions on the errors of the reduced-form VAR. The identification scheme turns out to be extremely important in isolating the effects of a particular shock. Suppose that the VAR process has no constant terms and there is only one regime $(s_t = 1)$, such that $\Xi(s_t = 1) = I$. Using (1), the model can be rewritten in a reduced-form VAR as follows $y'_t = x'_t B + \mu'_t$ $with$ $B = FA_0^{-1}$ and $\mu'_t = \varepsilon'_t A_0^{-1}$ where $x'_{t-1} = \left[y'_t \dots y'_{t-1} \right]$ and $F = \left[A_t \dots A_p \right]'$. The variance–covariance matrix Σ of the reduced-form VAR is a symmetric and positive definite matrix described as follows: $E\left[\mu_t \mu'_t \right] = \Sigma = \left(A_0 A'_0 \right)^{-1}$. These equations define a relationship between the structural and reduced-form parameters $(B,\ \Sigma)$, which is not unique. One can find two parameter points, $(A_0,\ F)$ and $\left(\widehat{A_0},\ \hat{F}\right)$, that are observationally equivalent if, and only if, they imply the same distribution of y_t for $1 \le t \le T$. That is, they have the same reduced-form representation $(B,\ \Sigma)$ if, and only if, there is an orthonormal matrix *P*, such that $A_0 = \widehat{A_0} P$ and $F = \hat{F}P$. The general idea is the same for a Markov-switching VAR model.

The most common restrictions to recover structural shocks are the so-called zero restrictions (following Sims, 1980). A most commonly used identification scheme is Cholesky decomposition, implying exact linear restrictions on the elements of A_0. This identification scheme utilizes a recursive contemporaneous ordering of variables, based on the assumption that it is possible to determine the variables that are not affected by contemporaneous changes in other variables and only respond to those changes with a lag.[6] Following this tradition, the contemporaneous matrix A_0 is an upper triangular matrix with the following recursive ordering: ip_t, p_t, r_t, hpi_t, cre_t. Following previous work by Leeper et al. (1996) and Christiano et al. (1999), we assume that the production sector (output and prices) does not respond contemporaneously to the credit and housing markets sector. Credit and housing markets have only lagged effects on real sector. Given that interbank lending rate is an end-of-quarter policy rate, we think it is reasonable to impose that the monetary authority responds immediately to the private (i.e., production) sector (see Walentin (2014)).

[6] Yet, economic theory is quite often silent about specific zero restrictions in SVAR models and for some applications the assumption of the causal ordering (i.e., which variable affects which) is problematic, since in reality variables can be jointly determined.

4. Empirical results

4.1. Model fit

In this section, we estimate and compare various types of models:

(i) With time invariant coefficients.

(ii) Each equation allows coefficients to change under one regime Markov-switching process.

(iii) The real estate sector equation allows coefficients to change under one regime Markov-switching process.

(iv) The real estate sector and credit equation allow coefficients to change under one regime Markov-switching process.

Table 1. Model fit[7]

Model specification	UK	NO	SE	CH	CA
Model with time invariant coefficients	1714.6	977.8	**1217.3**	1855.7	1610.9
Model with 2-regimes in all equations	1777.2	975.0	1200.4	1840.4	1599.1
Model with 2-regimes in RE equation	**1784.5**	980.8	1210.2	**1896.7**	**1643.9**
Model with 2-regimes in RE and credit equations	1780.1	**985.0**	1205.7	1896.1	1639.5

Source: Own calculations.

Note: The marginal data densities (MDDs) are computed based on the Sims et al. (2008). It is worth emphasizing that the MDDs in that table is provided in Log-likelihood scale so that differences of one or two in absolute value mean little, while differences of ten or more imply significant odds in favor of the higher-marginal-data density model. We use the Sims et al. (2008) method to compute the MDD for each regime switching model. For the constant parameter model, we use the Chib (1995) procedure (see Lhuissier (2017) for discussion).

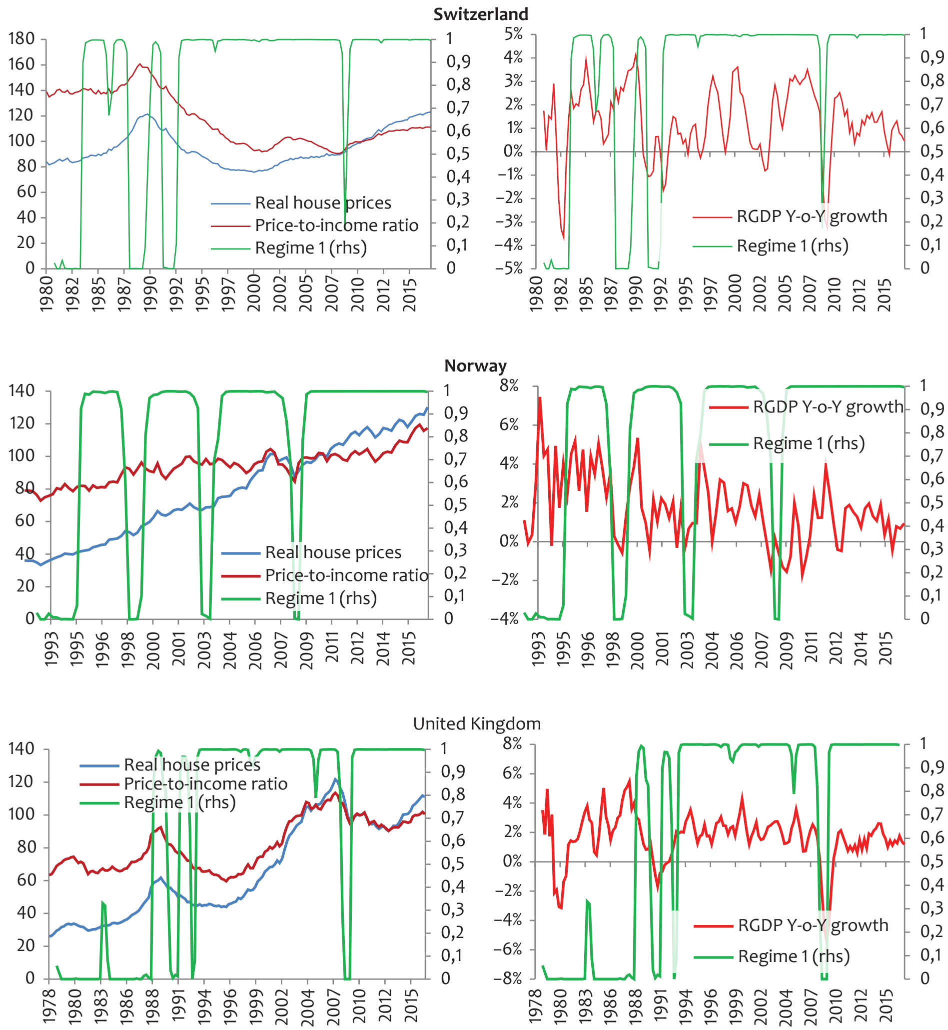
In models (ii)–(iv) we also allow the variance of all structural disturbances to follow another independent Markov process with two regimes.[8] Specifications in models (iii)–(iv) include only a subset of the equation coefficients to vary over time. It is possible that only real estate prices and credit change, while other sectors of the economy remain unchanged over time. In particular, model (iii) allows just for coefficients in real estate equations to change, therefore, it can be interpreted as the model of the economy with changing asset-pricing behavior while remaining

7 The results shown in this paper are based on 100000 draws with the Gibbs sampling procedure. We discard the first 5000 draws as burn-in, then keep every 10th draw.

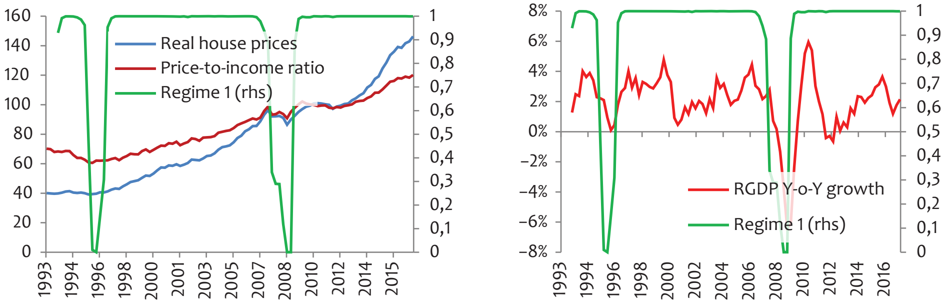
8 As shown by Sims (2001) to avoid the bias in estimates, the equation coefficients should be allowed to vary across time only if heteroscedasticity is taken into account i.e., the model allows shock variances to vary independently of coefficients (see Lhuissier et al. (2015) and Lhuissier (2017) for further discussion).

sectors of the economy do not change. In model (iv) we allow just for coefficients in real estate and credit equations to vary, as many studies state that credit market dynamics changes during the housing price booms.

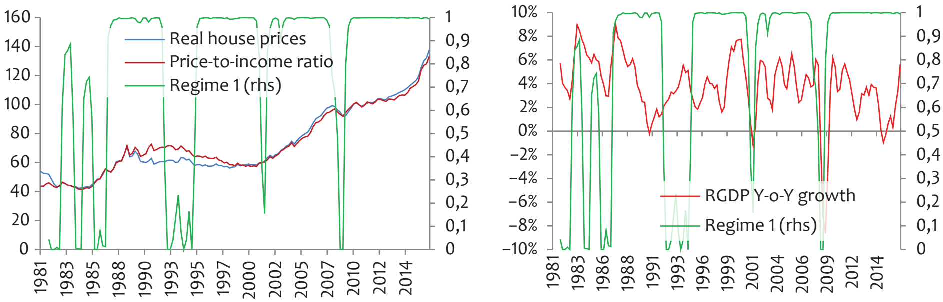
Figure 2. Smoothed regime probabilities



Sweden



Canada



Source: Own calculations.

Note: The figure provides smoothed probabilities (at the mode) produced from the (iii) -models.

We compare our models based on marginal-data-density (MDDs), which is a measure of model fit. Table 1 reports the log-value of MDD for each model. The results are heterogeneous across countries; however, it seems that data favor models associated with changes in real estate equation coefficients in the United Kingdom, Switzerland, and Canada. For those countries log-value of the MDD associated with this model remains above the values of the other MDDs of constant parameter model. For Norway the best fit model is the model with 2-regimes in RE and credit equations. The constant-parameter model is preferred in Sweden. However, log-value of the MDDs between the different models is quite close in Sweden and Norway which could be expected as data samples used in those countries do not capture a full housing cycle (see Figure 1). In the later sections we present some key results produced from the model (iii) for each country. While it is not necessarily the best-fit model for all countries, we want our results to be comparable.

4.2. Regimes fit

Figure 2 shows the probabilities of a specific regime for each Markov-switching process over time produced by model (iii). The probabilities are smoothed using full-sample information in calculating the regime probabilities at each date.

When looking at the process in which RE-equation coefficients from the system are allowed to change, it is apparent that regime 1 was dominant during the two periods of housing price downturn. In contrast, regime 2 dominates during normal/growth times. It is worth noting that results are intuitively appealing as for all countries regime 1, or the "crisis regime", turns on during the 2008–2009 financial crash. In addition to this, regime 1 turns in relevant times (economic downturns) for most countries.

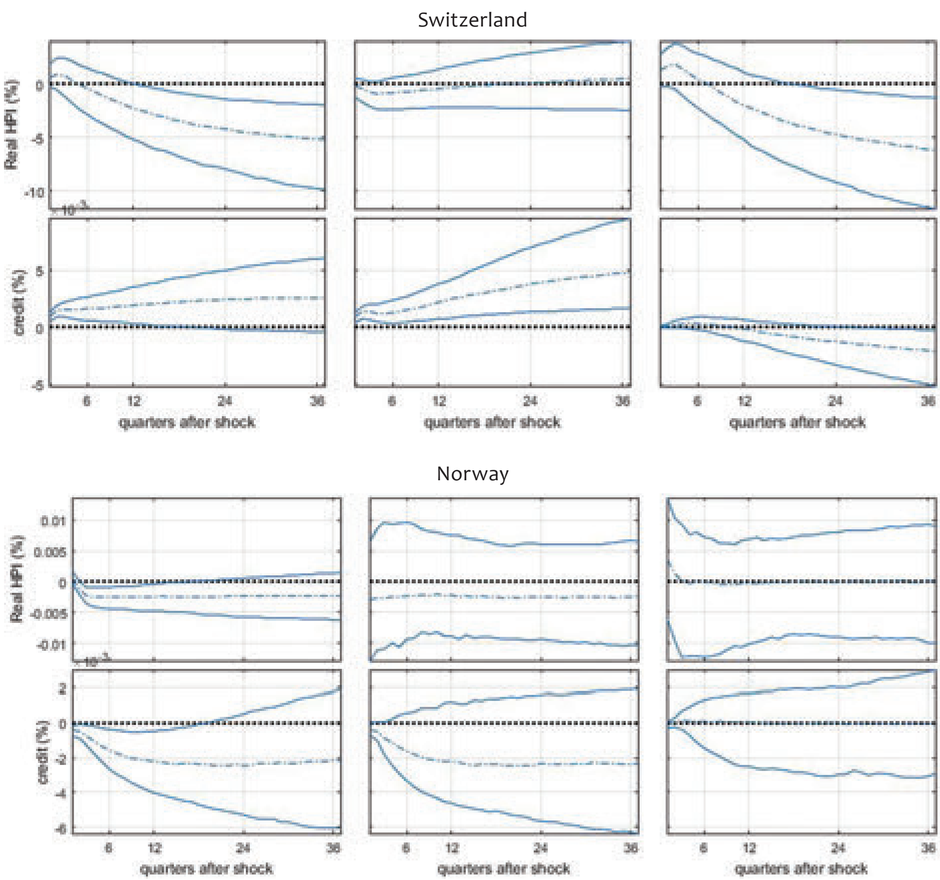
For Switzerland, regime 1 turns on in late 90s, which corresponds to the downturn in a countries' housing boom. For Norway. regime 1 captures the downturn at the start of the sample (this can be explained by the Norwegian housing market crash in 1989). Two additional times when the regime 1 turns on (in 1997 and in 2002) are less convincing. The UK models' regime switches are quite convincing as they match boom and bust episodes fairly well. For Sweden, the model picks up one additional regime switch (in 1994), which is short lived and hard to explain. For Canada regime 1 also picks up the post-1989 bubble period. Overall, the fit of regimes appears convincing for all countries.

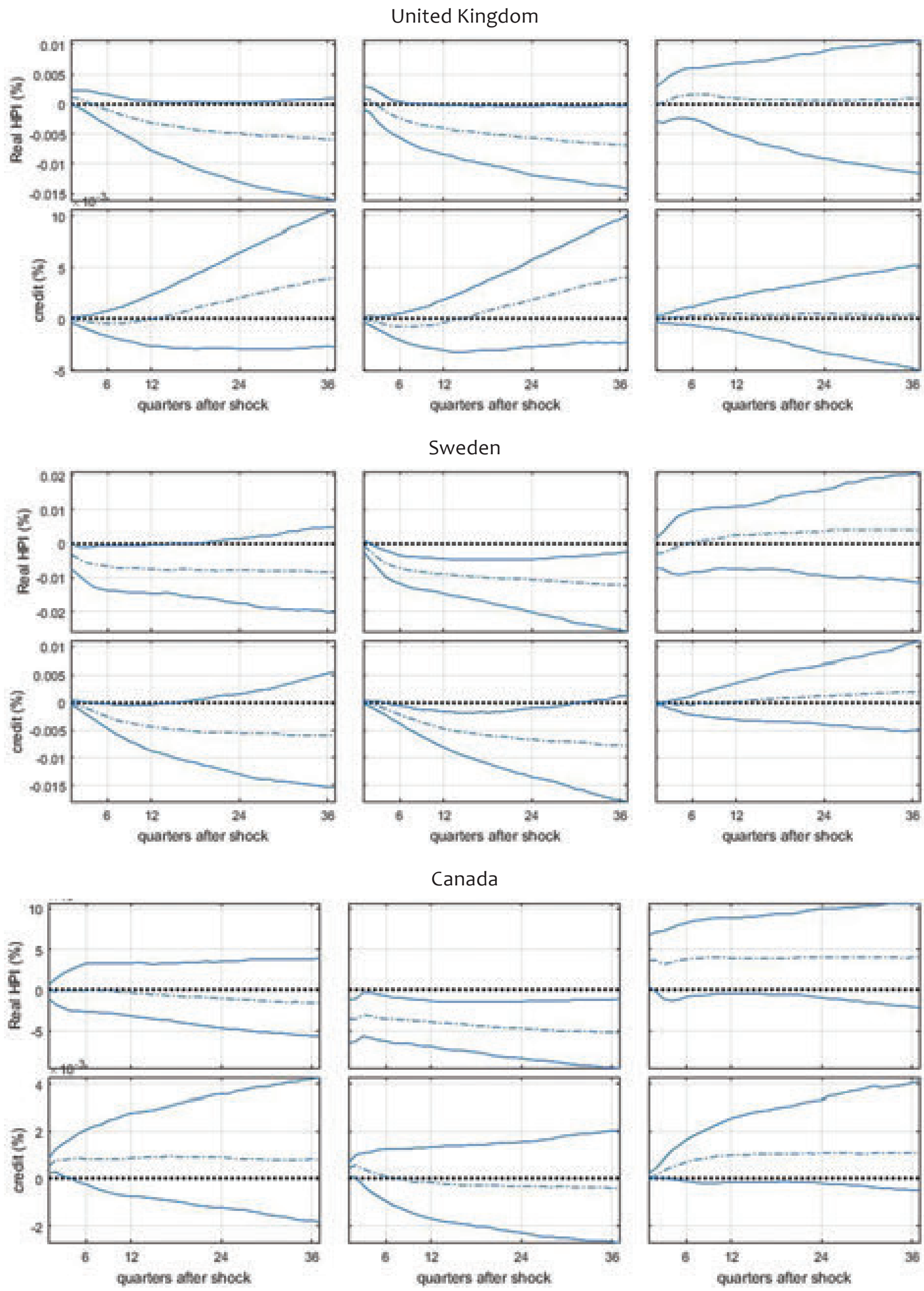
4.3. Regime-dependent dynamic effects of structural shocks

To illustrate the differences in dynamics across the two regimes in the systematic behavior of the real estate sector (and its effects on broader economy), we check the response of the economy to a structural monetary policy shock. For comparability across regimes, the monetary policy shock is scaled to a 25 basis points increase in interest rate in the first period. Figure 3 illustrates the impulse responses of endogenous variables across the two regimes. We provide responses of deviation of real house prices ("Real HPI") and real household credit ("CRED") in percent as the series entered model in log-levels. For each panel, the median is reported in the dotted blue line and the 68% error bands in solid lines.

Figure 3 depicts that impulse-response functions to monetary policy during different regimes tend to differ in some cases, though the results are not uniform across the countries. In Switzerland, Norway, Canada the monetary policy shocks during the "crisis-regime" have a more persistent effect on housing prices, while in the United Kingdom and Sweden, the responses are rather similar. In contrast, the impulse-response of monetary policy shocks on household credit tends to be quite similar in magnitude and shape for all countries, except for Canada. In Canada the impulse-response to monetary policy shocks effect on credit is more persistent during the crisis regime, while during normal times it tends to be short-lived. In Sweden and Norway these shocks in both regimes are very similar. However, for other countries, these shocks have more pronounced effect on other endogenous variables during the crisis regime.

Figure 3. Impulse responses of real house prices and household credit to a 25 bps monetary policy shock





Source: Own calculations.

Note: Impulse-response functions to monetary policy shock under both regimes from model (iii). The first and second column report impulse responses of endogenous variables under different regimes. The last column displays the difference between the two regimes. In each case, the median is reported in dotted line and the 68% error bands in solid lines.

Conclusions

In this paper we have constructed a model to identify the different regimes in the housing market and analyzed whether the effects of structural shocks depend on the regime the housing market is in. To do so we build a Markov-switching vector autoregressive models for five economies (Sweden, Switzerland, United Kingdom, Canada and Norway) with an independent monetary policies. Our main results are twofold:

(i) Data favor the models associated with changes in real estate equation coefficients in the United Kingdom, Switzerland, and Canada. For Sweden and Norway, all model fits are quite similar, which could be expected as data samples in those countries do not contain a full housing cycle.

(ii) We do not find the systemically significant differences in the responses of monetary policy shocks.

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Annexes

Annex 1 – Data

All data are quarterly. Data are taken from the OECD database with the exception of the housing price data, which are taken from the BIS database. The length of the data sample is country dependent:

(i) Switzerland (from 1980q1 to 2017q1);
(ii) Norway (from 1992q1 to 2017q1);
(iii) United Kingdom (from 1978q1 to 2017q1);
(iv) Sweden (from 1993q1 to 2017q1)
(v) Canada (from 1981q1 to 2017q1)

Chapter 17

Hedonic analysis of office and retail rents in three major cities in Poland

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Introduction

The aim of the article is to investigate rents in the office and retail market in three Polish major cities with the hedonic regression method in order to find their determinants. The rental income which a property generates for its owner is used to pay back a mortgage or pay the dividend to the shareholders. The rental income is used in the valuation process, when the income approach is applied, to estimate the value of a building that is being sold. Purchase transactions in the market are rather seldom and therefore, the rent levels, which are more frequently available, are a good starting point. The rent which a certain building can obtain is determined by its attributes, such as its location and quality and the supply and demand for such attributes on the market. The concept of the hedonic regression of property prices was introduced by Rosen (1974) and applied by Olszewski, Waszczuk and Widłak (2017) for the residential property prices in Warsaw, and by Leszczyński and Olszewski (2015) for commercial property prices in Poland. Chegut, Eichholtz and Rodrigues (2013) used the hedonic regression and generated an office price index for the London market while in another article Chegut, Eichholtz and

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The initial and abbreviated version of this paper was presented in *Report on the situation in the Polish residential and commercial real estate market in 2016* (NBP, 2017).
This article presents the opinions of its authors and not necessarily the official position of the Narodowy Bank Polski.

Rodrigues (2015) analyzed the rents of office space in Hong Kong, London, Los Angeles, New York City, Paris, and Tokyo. We follow their approach and run our regressions for three large cities in Poland. An overview of the commercial property market in Poland and a more detailed description of the real estate market in the analyzed cities is presented in NBP's report (2017).

Our analysis points out the determinants of rent levels in the office and the retail market, which are partially common for all three analyzed cities. We also show that there are significant differences among the cities, which result from the fact that two are monocentric and one is polycentric. The analysis covers Warsaw, which is the capital city and also the largest office market. Also Poznań, which is located close to the international road E30, and Tri-City, which has three city centers is analyzed.

An initial inspection of the rent data shows that rents in the retail market vary among shopping malls and also between various shops located in the same mall. We decided to analyze rents for individual shops. In the case of office buildings we do not observe significant differences among office space in the same building, but only differences among buildings. If there are small differences in the same building, they can most likely be attributed to the bargaining power of the owner and the tenant and also to the time the contract was negotiated. As the dominant part of the offices and shops rental agreements is denominated in euro, this currency was used in our calculations. The object of the analysis are monthly rents per sq. m, which have been logarithmized. In the case of office buildings, office spaces over 100 sq. m are analyzed, and in the case of shopping centers, shops with an area of 100 to 500 sq. m were analyzed. The data was collected by Narodowy Bank Polski, more details about the data collection as well as information about the average rent levels can be found in NBP's report (2017).

1. Analysis of rents for the three cities

1.1. Tri-City – offices

The Tri-City office market is the largest in northern Poland and the fourth office market in the country. At the end of 2016 the office stock amounted to around 634 thousand sq. m. (see Colliers International, 2017). Average monthly rental rates quoted in EUR amounted to 12.0 EUR / sq. m for class A office buildings and 10.7 EUR / sq. m for Class B office buildings at the end of 2016 (see NBP, 2017).

It is important to point out that rental rates in office buildings are affected by many factors, among others: the building's class, its location and its features. The estimation of the econometric model allowed to capture the factors determining the rental rates. According to the hedonic model, whose coefficient of determination (R^2) amounted to 52.4%, the average rent for office space in the Tri-City is significantly affected by the location. Buildings located in the center of Gdynia have a rent that is by 10.8% higher than the average and rents of offices in Gdańsk Oliwa are higher by 15% than the average rent. Interestingly, for the Tri-City we do not find that the building class has an impact on the rent, as the parameter is insignificant. Other important features in the model that affect the rent are: the size of the leasable area in the building, the number of parking spaces and the number of floors in the building. What is more, larger buildings obtain higher average rents, the same applies for higher buildings. The number of parking lots has a significant and negative effect. This finding results most likely from the fact that there are limits on the number of parking lots in new constructed buildings in Tri-City. Newer buildings are generally technically better, obtain higher rents than the old ones, but they have fewer parking spaces than older ones and thus the coefficient is negative.

Table 1. The results of the estimation of office space rents in EUR in Tri-City

ln rent sq. m EUR	Coefficient	Standard error	Statistical significance
ln leasable area	0.0651418	0.0298663	**
ln sum of parking lots	−0.0546121	0.0152096	***
building class B	−0.104356	0.118931	
Gdańsk-Oliwa	0.150151	0.0767430	*
Gdynia-city center	0.108594	0.103608	
Gdańsk	−0.209509	0.0847688	**
ln number of floors	0.197931	0.0698204	**
ln age plus 2	−0.0842997	0.0837664	

The regression was run with OLS, using 28 observations, the R2 is 52%.
Source: own calculations based on NBP data.

1.2. Tri-City – retail

The Tri-City market is the third largest retail market in Poland, there are about 742 thousand sq. m of space located in twenty seven shopping centers (see Colliers International, 2017). Most of the buildings are located in the Tri-City itself (24 shopping centers). Most of the retail space in the Tri-City was put into use after year 2000. However, many facilities have been modernized and expanded. In terms of location, a division into the more commercially-sought southern part of the Tri-City and the relatively low-saturated northern part is visible. In recent years, a number of shopping centers was established with the majority of retail and service objects located in the vicinity of new housing estates. Large retail facilities concentrate along the main road running along the Tri-City and the adjacent beltway. The average monthly rent at the end of 2016 amounted to 31.9 EUR / sq. m (see NBP, 2017).

Table 2. The results of the estimation of retail space rents in EUR in Tri-City

ln rent sq. m EUR	Coefficient	Standard error	Statistical significance
retail centers in Tri-City	0.403396	0.102632	***
leading centers – fashion and accessories	0.541561	0.0842750	***
ln service costs	0.386619	0.0682655	***
ln size of a single shop	−0.318038	0.0592776	***
ln age plus 2	0.139036	0.0641847	**
ln sum of parking lots	−0.0769538	0.0472977	
ln number of shops in the building	−0.0548186	0.0785610	
constant	3.39789	0.510524	***

The regression was run with OLS, using 419 observations, the R2 is 50%.
Source: own calculations based on NBP data.

The analysis carried out using the hedonic regression method established that the rent level depends on the location of buildings. Retail objects in Tri-City are characterized by a much higher rent levels than objects outside of Gdansk, Sopot and Gdynia. The model confirms also significant differences in the level of rent per sq. m of space in shopping centers inside the Tri-City. In this market it is difficult to apply a classic model in which one can refer to the influence of the distance between the object and the city center on the rent level. The close borders of Gdańsk, Gdynia and Sopot made the Tri-City one urban space, connected by a main road. Selected downtown shopping and entertainment centers, which are leading places for fashion and accessories, showed significantly higher rents than traditional day-to-day shopping centers in housing estates and hypermarkets located on the outskirts of cities. High operating costs go hand in hand with a high rent. Their level is influenced by the costs incurred for investing in advertising and the appearance of the common area of the building. The number of available parking spaces and the number of shops in the building play no role. Newer buildings should generally receive higher rents than older ones[5]. However, we find that the

[5] To analyze the effect of the age we had to add 2 years to the age, because some buildings are rented before they are delivered to the market and we need to take the logarithm of this value.

sign on the age variable is positive. A potential explanation is that older buildings often have a favorable location, and if they were modernized, they receive higher rents than newer buildings. The size of a given shop also influences its rent level and the larger the single shop, the lower is the rental rate per sq. m.

1.3. Poznań – offices

The office market in Poznań, with a total supply of 428 thousand sq. m, takes the sixth position in Poland after Warsaw, Gdańsk, Kraków, Wrocław and Katowice (see Colliers International, 2017). The data collected by NBP (2017) show that in the end of 2016 average monthly rent quoted in EUR of a A-class office units amounted to 13.5 EUR / sq. m and rents in B-class buildings amounted to 12.0 EUR / sq. m.

The hedonic analysis shows that the rent depends on various factors connected with the location of a building as well as its individual features. The estimation of the econometric model of rent rates in office buildings in Poznań has identified the main variables which essentially influence the height of rent rates. The factor that mostly determines the level of rents is the building class. According to the estimated model, the rents in B-class buildings are on average by 16% lower than in A-class buildings. Further on, significant variables that negatively influence the rents are the distance from the center of the city as well as the age of the building. The most expensive office space is situated in buildings placed in the city center. The bigger the distance from the center of the city, the lower the rents are. The younger the buildings, and thus more modern, the higher their rent is. The size of the total leasable area in a building is statistically insignificant. The reason might be the fact that the analyzed buildings possess relatively similar attributes. The coefficient of determination amounts to 50%. We have to conclude that rents are also determined by other factors, that were impossible to identify. The estimated parameters of the model are shown in Table 3.

Table 3. The results of the estimation of office space rents in EUR in Poznań

ln rent sq. m EUR	Coefficient	Standard error	Statistical significance
ln distance from the center	−0.0820732	0.0331071	**
ln age of the building	−0.0875951	0.0335437	**
ln leasable space	−0.017167	0.0414553	
building class B	−0.161368	0.0894716	*
constant	3.50652	0.473187	***

The regression was run with OLS, using 25 observations, the R2 is 50%.

Source: own calculations based on NBP data.

1.4. Poznań – retail

The stock of modern retail space in the Poznań agglomeration amounted to 713 thousand sq. m at the end of 2016 (see Colliers International, 2017). Publicly available data indicates that there were twenty one retail objects and five other objects in the close vicinity of the city, situated mainly along the A2 motorway and in the close area of S11 expressway. According to the results of the rent analysis conducted by the NBP (2017), at the end of 2016 the average monthly rent of shops in shopping malls amounted to 31.9 EUR / sq. m.

Interestingly, the hedonic regression method shows that the main rent determinants are the size of the shop, the number of shops in a building and the profile of the retail objects. Shops in retail centers specialized in furniture have lower rents, what is also connected with their location in outskirts of Poznań. A factor that attracts the customers, and as a consequence acts towards the rent increase, is the number of shops in one object. The more shops in a mall, the higher the rents it generates are. A good location of the retail complex in the economic center of the city is captured by the variable economic center. Rents in retail facilities with a good location are by 13% higher than in retail objects located in the rest of the city. The number of the parking lots has a positive effect on rents. The coefficient of determination of the model amounted to about 55%, which shows that there are some factors determining the rents of retail spaces that are not explained by the model. The estimated parameters of the model are showed in the Table 4.

Table 4. The results of the estimation of retail space rents in EUR in Poznań

ln rent sq. m EUR	Coefficient	Standard error	Statistical significance
ln space of the shop	−0.382686	0.0356806	***
ln quantity of shops	0.375076	0.0401149	***
economic center	0.132408	0.0552929	**
furniture shopping center	−0.351021	0.109501	***
ln quantity of parking places	0.162222	0.0245902	***
ln the age of the building plus 2	0.157563	0.0295405	***
constant	1.84106	0.353092	***

The regression was run with OLS, using 656 observations, the R2 is 54.5%.

Source: own calculations based on NBP data.

1.5. Warsaw – offices

There is no doubt that Warsaw is the largest office market in Poland. At the end of 2016, the supply of office space in Warsaw exceeded 5 million sq. m (see Colliers International, 2017). Based on the NBP (2017) data on rents, at the end of 2016, the average monthly rent of office space in A-class buildings reached 21.5 EUR / sq. m. Furthermore, average monthly rents amounted to 14.3 EUR / sq. m and to 10.6 EUR / sq. m in B-class and C-class buildings respectively.

It should be noted that the results of the hedonic analysis confirm that the rent rate per sq. m of office space differs significantly between building classes. In comparison to rental rates listed in A-class office buildings, rents for office space located in B-class office buildings are lower and C-class buildings are characterized by the lowest rent levels. A factor shaping the rent level is also the age of the building. The older the office building, the lower the rental rates. Location of the office is also important. Buildings that are more distant from the city center have a lower rent. The size of the total leasable space in a building turned out to be statistically insignificant, which means that this parameter does not affect rent rates.

Table 5. The results of the estimation of office space rents in EUR in Warsaw

ln rent sq. m EUR	Coefficient	Standard error	Statistical significance
building class B	−0.268519	0.0348060	***
building class C	−0.405917	0.0572861	***
ln age plus 2	−0.0334447	0.0151385	**
ln distance from the center	−0.107016	0.0164691	***
ln leasable rea	0.00637991	0.0150051	
constant	3.76011	0.182586	***

The regression was run with OLS, using 152 observations, the R2 is 70%.
Source: own calculations based on NBP data.

1.6. Warsaw – retail

It is worthwhile noting that the retail market in the Warsaw agglomeration has a total leasable area of over 1.5 million sq. m (see Colliers International, 2017). According to publicly available data, there are seventy retail objects and nearly 80% of the leasable space is found in traditional shopping centers, over 12% in retail parks and the remaining 8% are located in outlet centers and specialist facilities. At the end of 2016, the average monthly rent of shops located in shopping centers amounted to 40.5 EUR / sq. m (NBP, 2017).

Nonetheless, the results of the analysis, presented in detail in Table 6, confirm that the transaction rent per sq. m of retail space differs between object types. In relation to the average, much higher rental rates are generated by objects with a wide range of retail, service and entertainment offering (captured by the retail_top variable). The rents are lower in small, local objects where the offer is limited to several shops and in outlet centers (captured by the retail_local_outlet variable). Facilities located in close proximity to the city center are characterized by higher rent rates. An important factor differentiating the rent is also the size of the shops in one object. Rental rates are lower in larger shops and larger in smaller ones, which can be explained with the occurrence of economies of scale.

Table 6. The results of the estimation of retail space rents in EUR in Warsaw

ln rent sq. m EUR	Coefficient	Standard error	Statistical significance
retail top	0.686302	0.0391673	***
retail local outlet	−0.297982	0.0318270	***
ln number of shops	0.0448462	0.0340733	
ln center distance	−0.157111	0.0272927	***
ln shop area	−0.400187	0.314142	***
ln age plus 2	0.0285242	0.0183706	
constant	6.67926	0.320211	***

The regression was run with OLS, using 925 observations, the R2 is 66%.

Source: own calculations based on NBP data.

Conclusions

Narrowing the scope, we find that location has an important effect on rent levels in office buildings. In Warsaw and Poznań they rise with the shortening distance to the city center and in Tri-City the center of Gdańsk and Gdańsk-Oliwa obtain the highest rents. In Warsaw, B-class buildings receive around 27% lower rents than A-class buildings, and C-class buildings receive rents lower by as much as 40%. In Poznań, B-class buildings receive 16% lower rents than A-class buildings. In Tri-City, there are no significant differences between the buildings' classes, while the number of floors in a building has a positive effect on rents. This is probably due to the fact that in the best locations the land is very expensive, so investors build high office buildings there. In Poznań and Warsaw, older buildings receive lower rents than newer buildings, but there is no such a relationship for Tri-City.

In the case of shopping centers, the location is important for all cities. In Warsaw, rents are falling along with the distance from the center. In the case of the Tri-City agglomeration shopping centers located in the city gain 40% higher rents than those located in the rest of the agglomeration, while in Poznań those located in the economic center receive 13% higher rents. In Warsaw, local small shopping centers and outlet centers, and in Poznań, centers specializing in furniture and home accessories receive lower rents than other types of shopping centers. Moreover, in Warsaw and in the Tri-City one can distinguish centers recognized as leading ones, which receive significantly higher rents than the rest of shopping centers (by 68% and 54%, respectively). Regardless of the location, the greater a single shop is, the smaller its rent per sq. m is, which may indicate the existence of economy of scale effects.

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Chapter 18

The robustness of office building investment in the low interest rate environment

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Introduction

Commercial real estate investment attracts a lot of capital, because it usually generates quite high returns. It is also a professional business, unlike the residential real estate market which is subject to regulations and political interventions. Especially under the historically low interest rate regime in the euro zone, a huge amount of foreign capital flows to the commercial real estate sector in Poland, also domestic investors start to be more active. The construction of new office space or retail space is a necessary element in the functioning of a modern economy and therefore investors are needed. As in every business, also here the risk of making a loss is involved. Central banks and financial supervisory authorities are interested in the performance of the commercial real estate sector, as it is very capital intensive and uses a high share of bank mortgages to finance the construction of new buildings. Olszewski (2013) provides an overview on how central banks monitor the market, while ESRB (2015) gives a good overview of the available data and definitions.

Commercial property, like any other, is immobile and irreversible, thus a bad investment decision is hard to be corrected once the building is finished. Banks allow mortgages that are as high as 70% of the total costs, which makes the investment, through the high leverage, more profitable to the investor, than it would be with a low leverage. Also the high leverage allows an investor to buy or build a way larger building than he could buy with his equity alone. It is a standard approach

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to use a leverage, but we have to ask ourselves when the size of the leverage makes the investment prone to interest rate shocks or increases in the vacancy rate. The business model of an investor is to collect money from other investors, take a mortgage, buy a building and rent it to third parties. The rent income should be large enough to serve the mortgage, all business costs and to use the profits for the payment of dividends for himself and the other investors. Brounen, Ling and Vaessen (2017) analyzed the returns of 723 listed real estate investment companies in 10 countries over the 1995–2015 period and found that their returns depend on the level of interest rates, and the relation is stronger when credit is tight and more expensive i.e., when interest rates rise.

In this paper we investigate what would happen with a commercial real estate investment if it was started under the historically low interest rates in the euro zone, which would suddenly return to the pre-crisis levels. Another potential shock can stem from the overbuilding of commercial space, which can lead to increases in the vacancy rate, thus reduce the stream of income from a property. We first present, how the simplified accounting of an investment in commercial property works. For this reason we explain how to calculate the rental income, the mortgage costs and the after tax income. Then, we explain how to calculate the internal rate of return, which can be compared against investor's benchmark to decide whether to start the investment at all. In a second step, assuming that the investment has been started and commercial property is operational we show how the mortgage costs, and in consequence the interest rate coverage ratio and the solvency of the investment, behave when interest rates go back to their usual, pre-crisis levels. We also investigate the robustness of such an investment in the case of rise in vacancy rates. This is calculated based on empirical data for the sample of 10 B-class office buildings located in Warsaw. The data on size, price and rent levels come from Narodowy Bank Polski (NBP) database on commercial property, while the mortgage conditions are derived from market observations.

The decision to analyze B-class buildings has several reasons. The first is that such office buildings represent the majority of the office stock, the second is that not only foreign but also domestic investors can relatively simply acquire such buildings. On the contrary, A-class buildings are huge, expensive and basically unreachable for Polish investment funds. Besides that, such buildings have usually very long rental contracts with big clients. It is unlikely that in the foreseeable future tenants would move out elsewhere. We focus on 10 buildings that have been chosen from around 100 such buildings in the NBP database[4]. The main

[4] For a detailed description of the NBP database on rents and transaction prices in the real commercial estate market see NBP (2017).

criterion was to find rather similar buildings in terms of price and rent levels. The average gross leasable area amounts to 9 000 sq. m, and at the end of 2016 the average rent per sq. m per month equalled 14 EUR. The market value[5] of those buildings was estimated with the updated hedonic model of transaction prices in the Warsaw office market introduced by Leszczyński and Olszewski (2015) and turned out to be 2 700 EUR per sq. m of leasable area. A hedonic analysis of rent levels, presented in Olszewski et al. (2018), was performed to make sure that the observed rents are representative for the whole market. Such an approach allows us to draw conclusions about the market in general. When we assume that the current vacancy rate in the analyzed buildings is not more than 5% (a level quite often found in the initial phase of the investment, when an office building has just been commercialized), the annual yield from the investment is 5.9%. We have to multiply the cold rent (fourteen euro per sq. m per month) times twelve months a year, times the occupation rate (95%), which gives the rental income per year per sq. m of GLA, that we now have to divide by the purchase price per sq. m. This yield does not take into account any external financing, which has a significant impact on the return on equity (RoE). If no external financing is used, the RoE equals yield. However, investors seek to use as much leverage as possible, to increase RoE. The exact calculation will be presented in Section 2, while here we show an example. Let us assume that the mortgage is non-amortizing, thus only the interest is paid, while the collateral has to be paid back after the end of the investment period, which is expected to be ten years. Currently the interest rate for euro denominated commercial mortgages in Poland is 2.5%. When the investor applies a 50% loan to cost ratio, his financial cost (neglecting all other costs and taxes) is $0.5*0.025*2700 = 33.75$ EUR per sq. m. His rental income is 158 EUR per sq. m., which leaves him a profit of 124.25 EUR. Because his equity is half of the price i.e., 1350 EUR per sq. m, his RoE equals $124.25/1350 = 9.2\%$. When the LTC is increased to 70%, the calculation is as follows: interest burden – 47.25 EUR, thus the profit amounts to 110.75 EUR, which divided by his equity ($0.3 * 2700 = 810$) gives RoE of 13.7%. Our simple example shows that it pays of, as long as bank financing is cheaper than the cost of own capital, to use as much leverage as possible. We will perform a more detailed analysis in Section 1.

[5] In reality the price an investor is willing to pay depends on the minimal yield he is willing to accept. Usually the yield increases with the increasing risk, as it is calculated as a risk free rate that can be obtained from investing in government bonds, plus the risk premium. It will be further developed in Section 2.

1. The accounting of a commercial investment and the stress test

The detailed accounting of the investment is based on the analysis presented by Trojanowski (2011) and the classical accounting standards. We assume that the loan to cost ratio is set at 60% or 70% percent. The mortgage has an interest rate of 2.5% per annum, which means that as interbank interest rates are close to zero, the mortgage taker pays only the markup of the bank. Financing is in euro, because it is around two percentage points lower than financing in Polish zloty. The maturity of the mortgage is 25 years, whereas the usual investment horizon is 10 years. This makes the mortgage de facto to be non-amortizing. Many investors and banks agree on such terms, because when the mortgage is fully amortizing over the short investment period, the mortgage costs are very high and the investment generates a negative cash flow in the first 2–3 years. This would mean that the investor has to add money out of his pocket, a situation which barely anyone would accept. Under normal conditions, the investor is able to sell the building after the investment period has ended and pay back the mortgage, or he has to roll over. The moral depreciation of a commercial property is much faster than the physical depreciation, and in order to make an old building attractive, the owner has to put a lot of money into its refurbishment. There is a significant risk that in bad times the value of the property will decline and investor will have major problems to roll over the mortgage. But this is a rather extreme case, and as we show later, it is more likely that the investor will have problems to pay the interest rate much earlier, if indeed shocks appear.

The operational costs such as cleaning and maintenance, property taxes, etc. are around 3.2 EUR per sq. m per month and the annual costs of the management of the special purpose vehicle are around 110 thousand EUR. The management costs are fixed, while the operational costs are transferred to tenant, thus depend on the vacancy rate. A drop in the occupation rate translates into lower rent income and higher operational costs for the owner, which reduces his stream of income.

In order to analyze the investment, two important indicators need to be calculated. The one that is important for the financial stability of the project is the debt service to income ratio (DSTI), which is calculated as the ratio of interest and capital payment to the EBITDA minus taxes. It should be below 1, which means that only a fraction of the EBITDA minus taxes is used to serve the mortgage. The higher the indicator, the higher is the risk that the investor will not be able to pay the mortgage. The EBITDA are earnings before interest, taxes, depreciation and amortization.

Table 1. The record of profits and losses of the investor – different scenarios

The profit and losses account	Scen. 0	Scen. 1	Scen. 2	Scen. 3	Scen. 4	Scen. 5	Scen. 6	Scen. 7	Scen. 8	Scen. 9
Revenues	**1 761 084**	**1 761 084**	**1 761 084**	**1 761 084**	**1 668 395**	**1 575 706**	**1 483 018**	**1 668 395**	**1 575 706**	**1 483 018**
Operating costs	341 772	341 772	341 772	341 772	341 772	341 772	341 772	341 772	341 772	341 772
Net operating income	**1 419 311**	**1 419 311**	**1 419 311**	**1 419 311**	**1 326 623**	**1 233 934**	**1 141 246**	**1 326 623**	**1 233 934**	**1 141 246**
Management costs	**110 000**	**110 000**	**110 000**	**110 000**	**110 000**	**110 000**	**110 000**	**110 000**	**110 000**	**110 000**
General and administrative costs	110 000	110 000	110 000	110 000	110 000	110 000	110 000	110 000	110 000	110 000
EBITDA	**1 309 311**	**1 309 311**	**1 309 311**	**1 309 311**	**1 216 623**	**1 123 934**	**1 031 246**	**1 216 623**	**1 123 934**	**1 031 246**
Amortization	437 970	437 970	437 970	437 970	437 970	437 970	437 970	437 970	437 970	437 970
EBIT	871 341	871 341	871 341	871 341	778 653	685 964	593 275	778 653	685 964	593 275
Financial costs	360 531	432 949	578 034	723 405	360 531	360 531	360 531	432 949	578 034	723 405
Gross profit	**510 810**	**438 392**	**293 307**	**147 936**	**418 121**	**325 433**	**232 744**	**345 704**	**107 930**	**130 129**
Losses from previous years	0	0	0	0	0	0	0	0	0	0
Income tax rate	19%	19%	19%	19%	19%	19%	19%	19%	19%	19%
Income	97 054	83 295	55 728	28 108	79 443	61 832	44 221	65 684	20 507	0
Net profit	**413 756**	**355 098**	**237 579**	**119 828**	**338 678**	**263 601**	**188 523**	**280 020**	**87 423**	**130 129**

Source: own calculations based on NBP data.

Table 2. The free cash flow for the investor (FCFE) – different scenarios

	Scen. 0	Scen. 1	Scen. 2	Scen. 3	Scen. 4	Scen. 5	Scen. 6	Scen. 7	Scen. 8	Scen. 9
Inflows										
EBITDA	1 309 311	1 309 311	1 309 311	1 309 311	1 216 623	1 123 934	1 031 246	1 216 623	1 123 934	1 031 246
Sum of inflows	**1 309 311**	**1 309 311**	**1 309 311**	**1 309 311**	**1 216 623**	**1 123 934**	**1 031 246**	**1 216 623**	**1 123 934**	**1 031 246**
Outflows										
Income tax	97 054	83 295	55 728	28 108	79 443	61 832	44 221	65 684	20 507	0
Interest payments	360 531	432 949	578 034	723 405	360 531	360 531	360 531	432 949	578 034	723 405
Capital installment	425 543	398 121	347 256	301 527	425 543	425 543	425 543	398 121	347 256	301 527
Sum of outflows	**883 128**	**914 364**	**981 018**	**1 053 040**	**865 518**	**847 907**	**830 296**	**896 753**	**945 797**	**1 024 932**
FCFE	**426 183**	**394 947**	**328 293**	**256 272**	**351 105**	**276 027**	**200 950**	**319 869**	**178 137**	**6 314**

Source: own calculations based on NBP data.

The second important indicator describes the profitability of the investment, that is the return on equity (RoE). In the classical analysis one calculates the internal rate of return of the project for its whole duration and compares it with a benchmark that is set by the investor. Investors consider not only the current cash flow but also their capital gains = when the investment is finished and the property is sold. We will come back to this in Section 3, for now only analyzing the first year of the investment.

We now move to the record of profits and losses, which is presented in Table 1. The baseline scenario is denoted as 0, under which the mortgage interest rate equals 2.5% and the vacancy rate is 5%. The annual cash flow is the rental income and the coverage of the operational costs transferred to the tenants, multiplied by the rented space *(14 EUR / sq. m / month + 3.2 EUR / sq. m / month) × 12 × 9000 sq. m × 0.95 = 1 761 084 EUR*. Next, we subtract the operational costs of the whole building *(3.2 EUR / sq. m / month) × 12 × 9000 sq. m*, by which we obtain the net operating income *(NOI) = 1 419 311 EUR*. In the consecutive step we subtract the administration costs of the special purpose vehicle which owns the property and obtain the earnings before interest, taxes, depreciation and amortization (EBITDA), which amount to 1 309 311 EUR. Maximum amortization of the building in Poland is 2.5% per year. After subtracting this value EBIT is obtained, which are earnings before interest and taxes. Then, we subtract the financial cost, namely the interest payment and obtain the gross profit. In the last step after subtracting taxes one gets net profit, which amounts to 413 756 EUR.

The accounting presented above serves to calculate the free cash flow to equity (FCFE), which is presented in Table 2. We start with the previously calculated EBITDA and subtract the taxes, the interest and principal payment, which leads us to the FCFE that amounts to 426 183 EUR. We assume that in the analyzed period there will be no capital expenditures, that is no refurbishment is done.

1.1. Stress test to the DSTI and the FCFE

We now analyze how the DSTI indicator performs when the interest rate increases to 3%, 4% and 5% (scenarios 1–3). The results for an assumed loan to cost (LTC) ratio of 60% are presented in Table 3. The investment will be still profitable, however not as much as under the baseline scenario. Under scenario 3 the RoE will fall under 3%, a value that can be easily obtained with risk-free government bonds. It is likely that a part of investors will exit the market, which would lower the value of the shares. Under all three scenarios the DSTI does not exceed 0.8, a level which is considered safe for banks. It means that no more than 80% of the after tax income the property generates is used to pay the mortgage. Such an level is considered as safe by banks. The results are also presented in Table 4, where safe levels are marked in green, worrisome in yellow and risky ones in red.

Table 3. Analysis of the DSTI and ROE from free cash flow for the investor (FCFE) – different scenarios, LTC = 60%

	Scen. 0	Scen. 1	Scen. 2	Scen. 3	Scen. 4	Scen. 5	Scen. 6	Scen. 7	Scen. 8	Scen. 9
DSTI	0.65	0.68	0.74	0.80	0.69	0.74	0.80	0.72	0.84	0.99
ROE	4.4%	4.1%	3.4%	2.6%	3.6%	2.8%	2.1%	3.3%	1.8%	0.1%

Source: own calculations.

Another stress scenario presumes that the vacancy rate increases from the baseline 5% to 10%, 15% and 20% (scenarios 4–6). In Warsaw the current vacancy rate in the market is 14% and our stress test seems to be reasonable. Lease contracts are signed for 3–10 years but firstly, some contracts are always close to maturity, secondly, when the market is in a bust phase resulting in tenants' economic problems, they are willing to pay a fee to break the contract and exit the building. A similar situation can evolve in a very good market, when a particular building will be surrounded by better buildings with even lower rents. When the vacancy rate increases, the rental income declines, and moreover, the owner cannot shift some of the variable operational costs to the tenants. In consequence of a vacancy rate of 20%, the RoE drops to 2.1% and the DSTI increases to 0.8. The owner will still generate a small profit and be able to pay the mortgage, but some investors might want to exit the market.

In reality, the two scenarios are connected, as an increase of the interest rate leads to economic slowdown, which deteriorates the demand for office space. We do not have any knowledge about the factual correlation but for sake of simplicity we assume that the scenarios go hand in hand. Therefore, an interest rate of 3% is connected with a 10% vacancy rate, 4% with 15% and 5% with 20%, respectively (scenarios 7–9). The rate of return under the three scenarios will amount to 3.3%, 1.8% and 0.1% respectively, while the DSTI will increase to 0.72, 0.84 and 0.99 respectively. The last two scenarios assume that the investor will have a hard time to pay the mortgage, while his rate of return will be very small. In sum, the investor will have strong incentives to exit the market and sell the building quickly. If this happens on a large scale, prices in the market will decrease, which will cause problems for banks which granted mortgages for office purchases. We also perform the same analysis with a higher LTC=70% (see Table 12), which leads to much worse results. Even a small increase of the interest rate or the vacancy rate brings the investor in an unfavorable position, while the combination of two shocks makes it very difficult to serve the debt and the rate of return drops close to zero. Our analysis allows to conclude that the LTC should be limited to at most 60%, whereas 50% would be even safer for the financing banks.

Table 4. DSTI and the return on equity at different levels of interest rates and vacancy rate; LTC=60%

		Credit interest rates			
Vacancy rate	DSTI/rate of return	2.5%	3%	4%	5%
	5%	0.65/4.4%	0.68/4.1%	0.74/3.4%	0.80/2.6%
	10%	0.69/3.6%	0.72/3.3%		
	15%	0.74/2.9%		0.84/1.8%	
	20%	0.80/2.1%			0.99/0.1%

Source: own calculations.

Table 5. DSTI and the return on equity at different levels of interest rates and vacancy rate; LTC=70%

		Credit interest rates			
Vacancy rate	DSTI/rate of return	2.5%	3%	4%	5%
	5%	0.75/4.2%	0.78/3.7%	0.85/2.7%	0.92/1.5%
	10%	0.80/3.2%	0.83/2.7%		
	15%	0.85/2.2%		0.96/0.6%	
	20%	0.92/1.1%			1.16/–2.2%

Source: own calculations.

2. Analysis of the profitability of the office investment over the investment horizon under various interest rate and vacancy rate scenarios

In the last section we perform the office investment profitability analysis over the whole investment horizon, this time on an average A class office building located in Gdańsk. The average size of the building is 22000 sq. m. and in the first half of 2017 the average monthly rent amounted to 20 EUR per sq. m. with an estimated investment cost of about 4000 EUR per sq. m. A discount rate of 7% was assumed for equity. We consider a mortgage with a 70% loan to cost ratio with a 25-year repayment period. The aim is to show how the profits evolve under two different scenarios with low interest rates and a low vacancy rate and also with a high interest rate and a high vacancy rate. The analysis bases on the comparison of the internal rate of return (IRR) with a discount rate that the investor sets for himself as a benchmark. A discount rate of 7%means that the investor will enter any investment with an IRR above 7% and will not be interested if the IRR is below 7%.

The analysis focuses on the following indicators: EBITDA, net profit, FCFE, IRR and the net present value (NPV) of the cash flows that are discounted with the previously set discount rate. We also investigate the debt service coverage ratio – DSCR, which is just the inverse of the previously discussed DSTI. It shows how many times the debt service can be covered with the net profit. The number should be at least one, and the higher it is, the easier can the investor cover the debt. The financial indicators for each year of the investment were presented in section 2, here we move directly to the results. The results under the baseline scenario, that is an interest rate of 2.5% and a vacancy rate of 5% are presented in Table 6.

Table 6. Financial performance of the investment over its duration under a 2.5% interest rate and a 5% vacancy rate

Year of the investment	EBITDA	Net profit	FCFE	DSCR
1	4 865 729	929 594	1 293 326	1.4
2	4 890 057	986 418	1 304 326	1.4
3	4 978 631	1 096 217	1 367 144	1.4
4	5 065 254	1 205 396	1 428 157	1.4
5	5 148 172	1 312 559	1 485 938	1.4
6	5 232 306	1 421 717	1 544 467	1.5
7	5 317 787	1 533 000	1 603 845	1.5
8	5 404 635	1 646 452	1 664 081	1.5
9	5 492 873	1 762 117	1 725 188	1.5
10	5 582 523	1 880 041	1 787 176	1.5
11	5 673 607	2 000 270	1 850 058	1.6
12	5 766 148	2 122 852	1 913 846	1.6
13	5 860 171	2 247 835	1 978 551	1.6
14	5 955 697	2 375 268	2 044 186	1.6
15	6 052 752	2 505 203	2 110 762	1.6
16	6 151 360	2 637 691	2 178 293	1.6
17	6 251 545	2 772 784	2 246 790	1.7
18	6 353 334	2 910 537	2 316 266	1.7
19	6 456 751	3 051 005	2 386 733	1.7
20	6 561 823	3 194 244	2 458 206	1.7

Year of the investment	EBITDA	Net profit	FCFE	DSCR
21	6 668 576	3 340 312	2 530 696	1.8
22	6 777 037	3 489 267	2 604 217	1.8
23	6 887 233	3 641 170	2 678 782	1.8
24	6 999 192	3 796 082	2 754 404	1.8
25	7 112 943	3 954 065	2 831 097	1.8
26*	7 228 514	4 089 606	6 269 224	-

** This is the first year in which the debt is paid in full, so there is no more debt service to be paid.*
Source: own calculations.

In each of the analyzed periods (25 years loan repayment period plus 1 year after repayment) the cash flows have a positive value with a certain margin of safety. The level of financial flows guarantees the correct service and repayment of loan liabilities within the assumed time horizon. In the adopted model, EBITDA, which is the basic economic indicator,is at the level of 4866 thousand EUR in the first year of operation and up to 7112 thousand EUR in the twenty-fifth year of operation.

The annual net profit increases gradually, along with the decrease in interest charges, from around 930 thousand EUR in the first year to over 3954 thousand EUR in the twenty-fifth year of operation. During the analysis period, the highest net profit was recorded in the first year after the full repayment of loan liabilities.

From the first to the twenty-fifth year of operation, the office building generates a positive FCFE. This means that the revenues generated at that time fully cover the expenses incurred and there is a financial surplus for the owners of the capital in each analyzed year of operation.

The debt service ratio (DSCR), which is the basic measure of the ability to service bank loan obligations from the rent income is above 1 over the entire loan repayment period, a level required by crediting banks. A debt coverage ratio below 1.0 would mean that the borrower does not generate a sufficient cash flow to cover the credit payment.

Table 7. Profitability of the investment measured with the net present value and internal rate of return, under a 2.5% interest rate and a 5% vacancy rate

IRR (for the equity of the investor at the initial date of the investment)	9.20%
NPV (discounted value of the future cash flows, after considering the investment expenditure and the residual value.)	9 962 279 EUR
Residual value (cash flow in the 26th year/ discount rate)	89 560 339 EUR
Discount rate	7.0%

Source: own calculations.

At the moment of analysis, the price of the property (its residual value) at the end of the investment horizon (after 25 years) exceeds 89 million EUR. This is a good result from the point of view of the venture's profitability. The calculated internal rate of return (IRR) equals 9.20%, thus higher than the assumed discount rate of 7%. The investment should be considered profitable as it will bring financial benefits. The greater the difference between the IRR (9.20%) and the discount rate (7.0%), the higher is the profitability and the safety margin of the project.

The net present value of the discounted future cash flows (NPV) for the adopted discount rate and the analyzed period is 9962 thousand EUR. This amount mirrors today's value of future income from our enterprise, after deducting today's expenditures. In other words it is profit we can expect from the project in today's value. It can be concluded that the purchase of an office building under the assumptions made allows for loan servicing and a profit.

We now want to check how the same investment will perform if, through various reasons, the interest rate increases to 5% and due to problems in the economy the vacancy rate increases to 20%. The results are presented in Tables 8 and 9. In the adopted scenario, the economic efficiency indicators deteriorated significantly and the investment becomes unprofitable (the internal rate of return for the invested capital is much lower than its expected rate of return). In the first years of operation of the office building, the investment generates losses, because the expenses outweigh the financial inflows due to the excessive burden of credit obligations. The investor will go bankrupt shortly. The net present value of the investment is also negative. Under such a stress scenario the investor will be willing to exit the investment as fast as possible. If this situation becomes common, property prices will fall further deteriorating investment results.

Table 8. Financial performance of the investment over its duration under a 5% interest rate and a 20% vacancy rate

Year of the investment	EBITDA	Net profit	FCFE	DSCR
1	3 948 412	–1067685	–174 748	0.96
2	3 968 154	–998598	–171 212	0.96
3	4 040 133	–884494	–125 998	0.97
4	4 110 802	–768609	–82 512	0.98
5	4 178 449	–652184	–42 175	0.99
6	4 247 068	–531832	–1 787	1.00
7	4 316 784	–407290	38 716	1.01
8	4 387 617	–278377	79 310	1.02
9	4 459 582	–144902	119 966	1.03

Year of the investment	EBITDA	Net profit	FCFE	DSCR
10	4 532 699	−6664	160 657	1.04
11	4 606 986	136548	201 351	1.05
12	4 682 462	284952	242 016	1.06
13	4 759 145	438781	282 616	1.06
14	4 837 055	598276	323 114	1.07
15	4 916 212	763691	363 469	1.08
16	4 996 635	935292	403 640	1.09
17	5 078 345	1113360	443 581	1.10
18	5 161 362	1298186	483 244	1.11
19	5 245 708	1490079	522 578	1.12
20	5 331 403	1689360	561 528	1.13
21	5 418 469	1896368	600 037	1.14
22	5 506 928	2111458	638 043	1.15
23	5 596 803	2335001	675 481	1.15
24	5 688 116	2567389	712 283	1.16
25	5 780 889	2809031	748 375	1.17
26*	5 875 147	2993379	5 172 997	-

** This is the first year in which the debt is paid in full, so there is no more debt service to be paid.*
Source: own calculations.

Table 9. Profitability of the investment measured with the net present value and internal rate of return, under a 5% interest rate and a 20% vacancy rate

IRR (for the equity of the investor at the initial date of the investment)	4.62%
NPV (discounted value of the future cash flows, after considering the investment expenditure and the residual value)	−10 601 694 EUR
Residual value (cash flow in the 26th year/ discount rate)	73 899 950 EUR
Discount rate	7.0%

Source: own calculations.

Conclusions

Our analysis presents the accounting of an office investment, both in the first year of the investment and over its whole duration. It should help to understand the risk which a commercial property investor and the bank that finances such an investment take. Our simple stress test shows how the return on equity and the debt service coverage ratio change when interest rates or vacancy rates rise, or both shocks appear simultaneously. We find that when the loan to cost ratio is at 60% the investment is relatively robust to the applied shocks, while when it increases to 70%, it can, under specific shocks, generate a negative cash flow and the investor will not be able to pay the mortgage. It should be noted that this is a very simplified analysis, and there are many details and other potential shocks that each investor should take into account.

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To unikatowa na polskim rynku pozycja, poruszająca najbardziej interesujące i szeroko dyskutowane problemy związane z rynkiem nieruchomości – od cykli i kryzysów poprzez problemy dotyczące funkcjonowania tych rynków i wyceny nieruchomości aż do związanych z nimi problemów społecznych. Pozycja zawodowa i doświadczenie poszczególnych autorów są zróżnicowane. Zróżnicowane są też kraje będące przedmiotem ich analiz. Pokazuje to wagę i uniwersalność poddanych dyskusjom problemów, związanych z tym, że współczesna cywilizacja staje się w coraz większym stopniu cywilizacją nieruchomości. Warto tu wspomnieć, że ostatni globalny kryzys rozpoczął się od rynku nieruchomości. W sposób naturalny zróżnicowana jest też metoda badawcza stosowana w poszczególnych rozdziałach – adekwatna do danego problemu i we właściwy sposób opisująca zjawisko. Reasumując, jest to bardzo dobra pozycja, zwłaszcza dla badaczy i analityków szeroko rozumianego rynku nieruchomości oraz dla studentów i doktorantów zajmujących się tą problematyką.

– z recenzji dr. hab. Leszka Pawłowicza, prof. Uniwersytetu Gdańskiego

This is a unique position on the Polish book market that raises the most interesting and widely discussed problems associated with the real estate market - from cycles and crises through the problems of the functioning of these markets and property valuation to related social problems. The professional position and experience of individual authors is diverse, as are the analyzed countries. This shows the importance and universality of the problems discussed, which is related to the fact that the contemporary civilization is increasingly becoming a civilization of real estate. It is worth mentioning that the last global crisis has also begun with the real estate market. The research method used in individual chapters is also naturally diverse - adequate to the given problem and describing the phenomenon in a good way. Summing up, this is a very interesting position, especially for researchers and analysts of the broadly understood real estate market, as well as students and PhD students dealing with this issue.

– Associate Professor Leszek Pawłowicz, reviewer of the book

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